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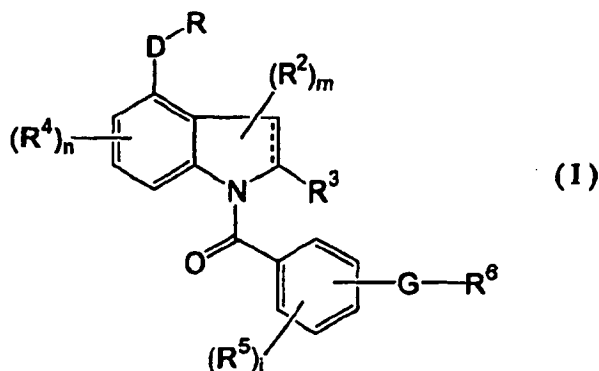
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(54) **INDOLE DERIVATIVES, PROCESS FOR PRODUCING THE SAME AND DRUGS CONTAINING THE SAME AS THE ACTIVE INGREDIENT**

(57) Indole derivatives represented by formula (I)



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wherein all symbols represent the same as that in specification), production methods thereof, and DP receptor antagonist comprising them as active ingredients.

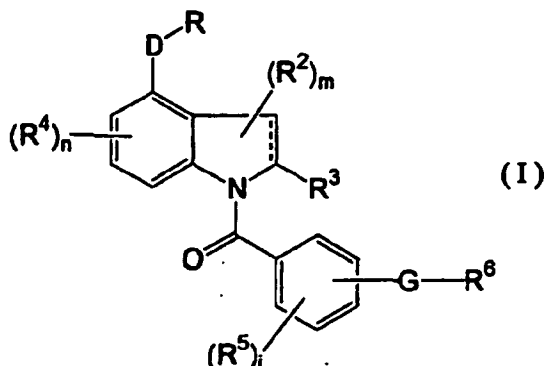
Since the compounds of formula (I) binds and antagonizes to DP receptor, they are useful for the prevention and/or treatment against allergic diseases, diseases accompanied with itching, secondary diseases generated by behaviors caused by itching, inflammation, chronic obstructive pulmonary disease, ischemic reperfusion disorder, cerebrovascular disorder, pleuritis complicated by rheumatoid arthritis, ulcerative colitis.

Description

TECHNICAL FIELD

[0001] The present invention relates to indole derivatives.

[0002] More specifically, the present invention relates to indole derivatives represented by formula (I):



wherein all symbols have the same meanings as described below), the non-toxic salts,
(2) productin methods, and
(3) medicines comprising them as an active ingredient.

BACKGROUND ART

[0003] Prostaglandin D_2 (hereinafter referred to as "PGD₂") are known as a metabolite in the arachidonic acid cascade, and are thought to be one of chemical transmitters that take part in allergic disease, for example, allergic rhinitis, bronchial asthma, and conjunctivitis allergic. It has been known that PGD₂ is produced from mast cells and free PGD₂ shows bronchoconstriction, permeability accentuation, vasodilation or shrinkage, mucus secretion promotion, and platelet aggregation inhibitory effect. It has been reported that PGD₂ induces airway contraction and rhinostenosis symptom in vivo and the increase in PGD₂ concentration has been recognized in the pathologic topical of systemic mastocytosis (mastocytosis) patients, nasal allergy patients, bronchial asthma patients, atopic dermatitis patients, and urticaria patients, etc. (*New Eng. J. Med.*, 303, 1400-1404 (1980), *Am. Rev. Respir. Dis.*, 128, 597-602 (1983), *J. Allergy Clin. Immunol.*, 88, 33-42 (1991), *Arch Otolaryngol Head Neck Surg*, 113, 179-83 (1987), *J. Allergy Clin. Immunol.*, 82, 869-77 (1988), *J. Immunol.*, 146, 671-6 (1991), *J. Allergy Clin. Immunol.*, 83, 905-12 (1989), *N. Engl. J. Med.*, 315, 800-4 (1986), *Am. Rev. Respir. Dis.*, 142, 126-32 (1990), *J. Allergy Clin. Immunol.*, 87, 540-8 (1991), *J. Allergy Clin. Immunol.*, 78, 458-61 (1986)). Also, PGD is considered to relate to neuro activities, especially, sleep, hormone secretion, and pain. Furthermore, there are reports suggesting participations in platelet aggregation, glycogen metabolism, ocular tension adjustment and the like.

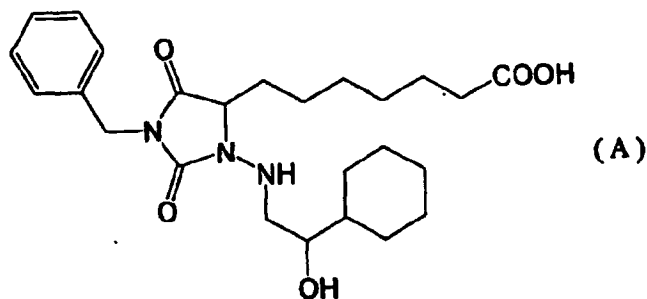
[0004] PGD₂ shows its effects by binding to DP receptor which is one of receptor thereof. A DP receptor antagonist binds and is antagonistic to its receptor so that it can inhibit the function. Accordingly, it is considered to be useful for the prevention and/or treatment of diseases, for example, allergic diseases (allergic rhinitis, allergic conjunctivitis, atopic dermatitis, bronchial asthma, food allergy, etc.), systemic mastocytosis, disorders due to systemic mastocyte activation, anaphylactic shock, bronchoconstriction, urticaria, eczema, psoriasis, allergic bronchopulmonary aspergillosis, paranasal sinusitis, migraine, nasal polyp, hypersensitive angitis, eosinophilia, contact dermatitis, diseases accompanied with itching (such as atopic dermatitis, urticaria, allergic conjunctivitis, allergic rhinitis, contact dermatitis, etc.), secondary diseases (such as cataracta, retinodialysis, inflammation, infection, dysgryphia, etc.) generated by behaviors caused by itching (scratching behaviors, beating, etc.), inflammation, chronic obstructive pulmonary disease, ischemic reperfusion disorder, cerebrovascular disorder, brain damage, hepatopathy, graft rejection, autoimmune disease, rheumatoid arthritis, pleuritis complicated by rheumatoid arthritis, osteoarthritis, crohn's disease, ulcerative colitis, pain and the like. Moreover, it is considered to relate to sleeping and platelet aggregation and to be useful for these diseases.

[0005] It is known that PGD₂ binds with chemoattractant receptor-homologous molecule expressed on Th2 cells (CRTH2 besides DP receptor, and has the migration action on Th 2 cell, eosinophil, and basophil (*J. Exp. Med.*, 193, 255-261 (2001), *Blood*, 98, 1942-1948 (2001)). Since PGD₂ is a ligand to both of DP and CRTH2 receptors in Th2

cells, eosinophils, and basophils in vivo, DP receptor antagonists are expected to bind with CRTH2 receptor, and to antagonize the biological activity.

[0006] So, it is considered to be useful for the prevention and/or treatment of diseases, allergic diseases, for example, allergic rhinitis, allergic conjunctivitis, atopic dermatitis, bronchial asthma, food allergy, *etc.*, systemic mastocytosis, disorders due to systemic mastocyte activation, anaphylactic shock, bronchoconstriction, urticaria, eczema, allergic bronchopulmonary aspergillosis, paranasal sinusitis, migraine, nasal polyp, hypersensitive angitis, eosinophilia, contact dermatitis, diseases accompanied with itching such as atopic dermatitis, urticaria, allergic conjunctivitis, allergic rhinitis, contact dermatitis, *etc.*; secondary diseases such as cataracta, retinodialysis, inflammation, infection, dysgryphia, *etc.* generated by behaviors caused by itching (scratching behaviors, beating, *etc.*), inflammation, chronic obstructive pulmonary disease, ischemic reperfusion disorder, cerebrovascular disorder, pleuritis complicated by rheumatoid arthritis, ulcerative colitis and the like.

[0007] Some PGD₂ receptor antagonists are known conventionally, and BW-A868C represented by the following formula (A) is considered to be the most selective:



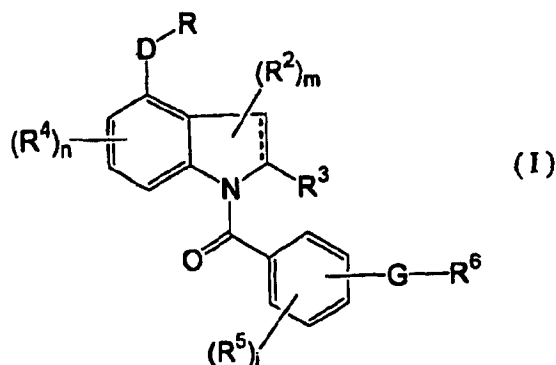
[0008] Recently, PGD₂ receptor antagonists comprising thromboxane derivatives have been published in WO 98/25915, WO 98/25919, WO 97/00853, WO 98/15502 and the like.

DISCLOSURE OF THE INVENTION

[0009] As prostaglandin receptors, a lot of receptor including the subtype exist and the pharmacological action is respectively different. Then, if a new compound that weakly binds to other prostaglandin receptors and specifically binds to PGD₂ receptor, especially DP receptor can be found, there is a possibility to become a medicine having a little side effect because of disappear of other actions, and discovery of such a medicine is necessary.

[0010] The present inventors intensively studied to find a compound which specifically binds to PGD₂ receptor, especially DP receptor and show an antagonistic activity and found that the object could be attained by indole derivatives represented by formula (I), and thus the present invention has been completed.

[0011] That is, the present invention relates to indole derivatives represented by formula (I):



wherein R represents -COR¹, -CH₂OR⁰, or -COOR²⁰, R⁰ represents a hydrogen atom or C2-6 acyl group, R¹ represents a hydroxyl group, C1-6 alkoxy group, -NR⁸R⁹ wherein R⁸ and R⁹ represent a hydrogen atom, C1-6 alkyl

group, $-\text{SO}_2\text{R}^{13}$ (R^{13} represents C1-6 alkyl group, C3-15 saturated or unsaturated carbocyclic ring, or 4 to 15-membered heterocycle containing 1 to 5 of nitrogen atom(s) sulfur atom(s), and/or oxygen atom(s).), R^{20} represents allyl or benzyl group.),

R^2 represents a hydrogen atom, C1-6 alkyl, C1-6 alkoxy, C2-6 alkoxyalkyl, a halogen atom, amino, trihalomethyl, cyano, hydroxyl, benzyl, or 4-methoxybenzyl group,

R^3 represents a hydrogen atom, C1-6 alkyl, C1-6 alkoxy, a halogen atom, trihalomethyl, cyano, or hydroxyl group,

R^4 and R^5 represent a hydrogen atom, C1-6 alkyl, C1-6 alkoxy, C2-6 alkoxyalkyl group, a halogen atom, nitro, amino, trihalomethyl, trihalomethoxy, cyano or hydroxyl group, respectively,

D represents a single bond, C1-6 alkylene, C2-6 alkenylene, or C1-6 oxyalkylene group,

$-\text{G}-\text{R}^6$ represents

1) G represents C1-6 alkylene that may be replaced by 1 or 2 of oxygen atom(s) and/or sulfur atom(s), C2-6 alkenylene that may be replaced by 1 or 2 of oxygen atom(s) and/or sulfur atom(s) (these alkylene and alkenylene group may be substituted by hydroxyl or C1-4 alkoxy group.), $-\text{C}(\text{O})\text{NH}-$, $-\text{NHC}(\text{O})-$, $-\text{SO}_2\text{NH}-$, $-\text{NHSO}_2-$, or diazo group,

R^6 represents C3-15 saturated or unsaturated carbocyclic ring, or 4 to 15-membered heterocycle containing 1 to 5 of nitrogen atom(s) sulfur atom(s), and/or oxygen atom(s) (these rings may be substituted by 1 to 5 group (s) selected from C1-6 alkyl, C1-10 alkoxy, C2-6 alkoxyalkyl, a halogen atom, hydroxyl, trihalomethyl, nitro, amino, phenyl, phenoxy, oxo, C2-6 acyl, C1-6 alkane sulphonyl, and cyano group.), or

2) together with G and R^6 ,

(i) C1-15 alkyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s),

(ii) C2-15 alkenyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s) (these alkyl, alkenyl, and alkynyl groups may be substituted by 1 to 12 of groups selected from C1-6 alkoxy, a halogen atom, hydroxyl, cyano, oxo groups, and $-\text{NR}^{11}\text{R}^{12}$ group wherein R^{11} and R^{12} represent a hydrogen atom, C1-6 alkyl, C2-6 alkenyl, phenyl, benzoyl, naphthyl, phenyl group substituted with C1-6 alkyl group, or C1-6 alkyl group substituted by phenyl or cyano group, respectively),

n represents 1 to 3,

m represents 1 to 3,

i represents 1 to 4,

----- represents a single bond or a double bond.), or non-toxic salts thereof,

(2) the production methods, and

(3) the medicines comprising them as an active ingredient.

[0012] As the C1-6 alkyl group in this specification, methyl, ethyl, propyl, butyl, pentyl, hexyl group, and isomers thereof are included

[0013] As the C1-5 alkyl group in this specification, methyl, ethyl, propyl, butyl, pentyl, and these isomers are included.

[0014] As the C1-6 alkoxy group in this specification, methoxy, ethoxy, propyloxy, butyloxy, pentyloxy, hexyloxy, and these isomers are included.

[0015] As the C1-10 alkoxy group in this specification, methoxy, ethoxy, propyloxy, butyloxy, pentyloxy, hexyloxy, heptyloxy, octyloxy, nonyloxy, decyloxy, and these isomers are included.

[0016] As the C1-4 alkoxy group in this specification, methoxy, ethoxy, propyloxy, butyloxy, and these isomers are included.

[0017] As the C1-15 alkyl group in this specification, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, and these isomers are included.

[0018] In this specification, the C1-15 alkyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s) represents the one which 1 to 5 of arbitrary carbon atom(s) of the above alkyl was/were replaced by oxygen atoms and/or sulfur atoms.

[0019] As the C2-15 alkenyl group in this specification, ethenyl, propenyl, butenyl, pentenyl, hexenyl, heptenyl, octenyl, nonenyl, decenyl, undecenyl, dodecenyl, tridecenyl, tetradecenyl, pentadecenyl, and these isomers are included.

[0020] In this specification, the C2-15 alkenyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s) represents the one which 1 to 5 of arbitrary saturated carbon atom(s) of the above alkenyl group was/were replaced by oxygen atoms and/or sulfur atoms.

[0021] As the C2-15 alkynyl group in this specification, ethynyl, propynyl, butynyl, pentynyl, hexynyl, heptynyl, octynyl, nonynyl, decynyl, undecynyl, dodecynyl, tridecynyl, tetradecynyl, pentadecynyl, and these isomers are included.

[0022] In this specification, the C2-15 alkynyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s) represents the one which 1 to 5 of arbitrary saturated carbon atom(s) of the above alkynyl group was/were

[0023] As the C2-6 alkoxyalkyl group in this specification, methoxymethyl, methoxyethyl, methoxypropyl, methoxybutyl, methoxy pentyl, ethoxymethyl, ethoxyethyl, ethoxypropyl, ethoxybutyl, propyl oxymethyl, propyloxyethyl, propyloxybutyl, propyloxyethyl, and these isomers are included.

5 [0024] As the C1-6 alkylene group in this specification, C_1 - C_6 alkylene, isopropylene, and these isomers are included.

10 [0026] As the C2-6 alkenylene group in enylene, and these isomers are included.

10 **[0027]** As the C2-4 alkenylene group in this specification, ethenylene, propenylene, butenylene and these isomers are included.

15 [0029] In this specification, as the C1-6 alkylene group that may be replaced by oxygen atom(s), the groups, which arbitrary carbon atoms of the above C1-6 alkylene group was replaced by oxygen atoms and/or sulfur atoms, are included.

by oxygen atoms and/or the sulfur atoms, are included.

[0032] The halogen atom in this specification represents trifluoromethyl, trichloromethyl

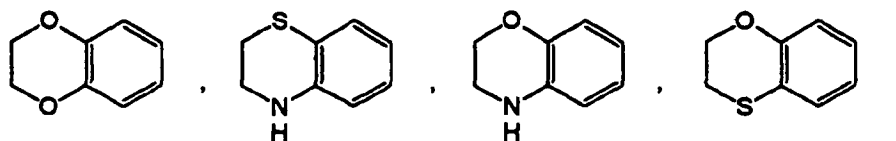
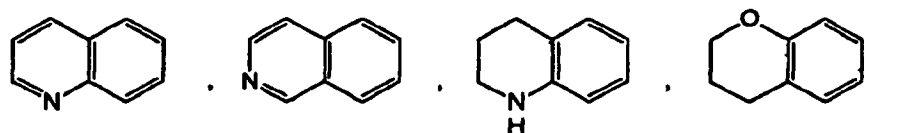
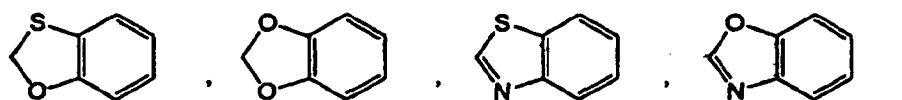
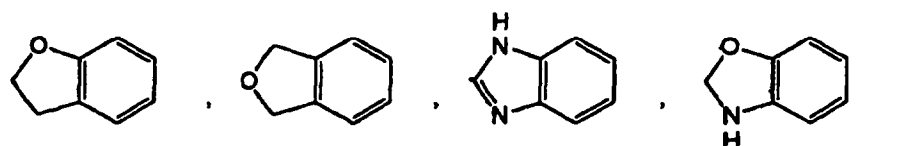
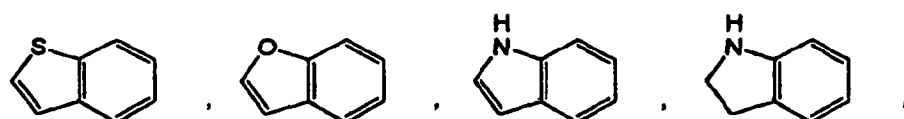
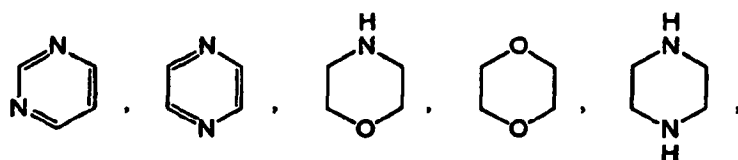
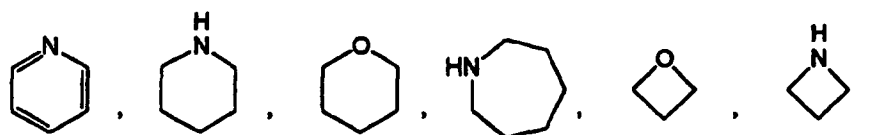
[0034] The trihalomethoxy group in this specification represents trifluoromethoxy, trichloromethoxy, tribromomethoxy, or triiodomethoxy.

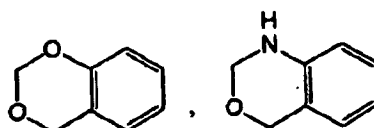
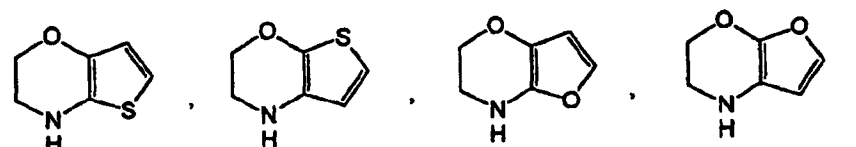
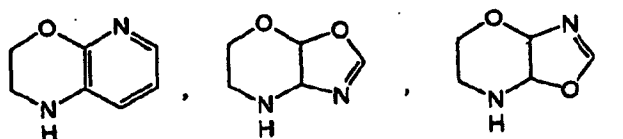
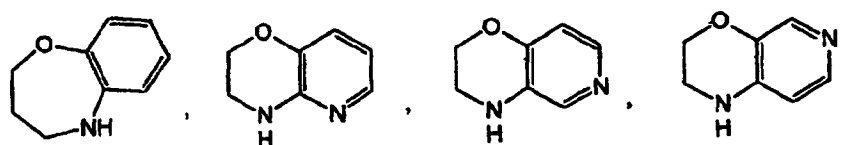
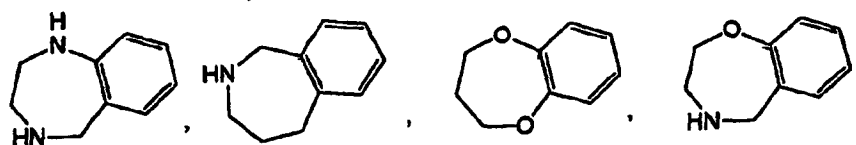
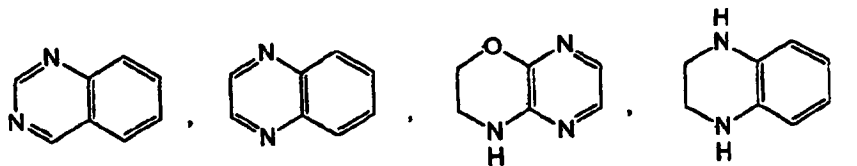
30 [0036] As the C1-6 alkanesulfonyl group in this specification, monosulfonyl, disulfonyl, trisulfonyl, tetrasulfonyl, pentanesulfonyl, hexanesulfonyl, and these isomers are included.

[illegible][illegible]

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[0040] As R in formula (I), -COR¹ or -CH₂OR⁰ group is suitable, and -COR¹ is more suitable.

[0041] As R⁰ in formula (I), a hydrogen atom or C2-6 acyl group is suitable, and a hydrogen atom is more suitable.

[0042] As R¹ in formula (I), hydroxyl or C1-6 alkoxy group is suitable, and hydroxyl or C1-4 alkoxy group is more suitable.

[0043] As R² in formula (I), a hydrogen atom, C1-6 alkyl, or C1-6 alkoxyalkyl group is suitable, and a hydrogen atom, C1-2 alkyl, or C1-2 alkoxyalkyl group is more suitable.

[0044] As R³ in formula (I), a hydrogen atom or C1-6 alkyl group is suitable.

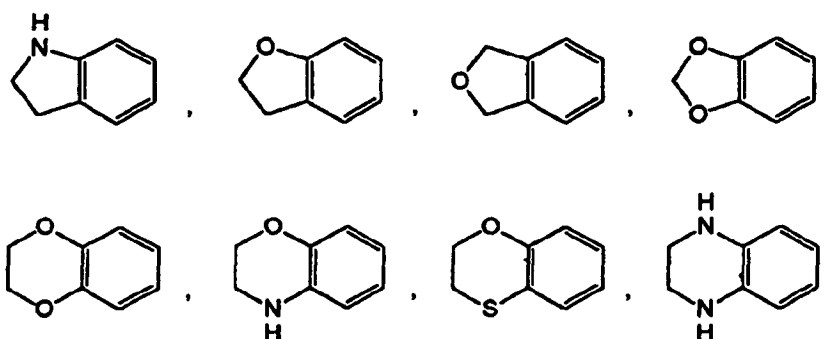
[0045] As R⁴ in formula (I), a hydrogen atom or C1-6 alkyl group is suitable, and a hydrogen atom or C1-2 alkyl group is more suitable.

[0046] As R⁵ in formula (I), a hydrogen atom or C1-6 alkyl group is suitable, and a hydrogen atom or C1-2 alkyl group is more suitable.

[0047] As D in formula (I), a single bond or C1-6 alkylene group is suitable, and a single bond or C1-2 alkylene group is more suitable.

[0048] As G in formula (I), C1-6 alkylene group that may be replaced by 1 or 2 of oxygen atom(s) is suitable, and C1-2 alkylene group that may be replaced by an oxygen atom is more suitable.

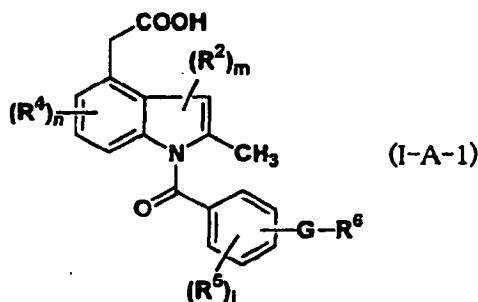
[0049] As R⁶ in formula (I), C5-10 carbocyclic ring wherein substituents are arbitrarily included, or monocyclic or 5 to 10-membered bicyclic heterocycles containing 1 to 3 of nitrogen atom(s), oxygen atom(s), and/or sulfur atom(s) are suitable, 9 to 10-membered bicyclic heterocycles containing 1 to 3 of nitrogen atom(s), oxygen atom(s), and/or sulfur atom(s), which arbitrarily contain substituents, are more suitable, and the heterocycles represented by the following, which arbitrarily contain substituents, are further suitable.



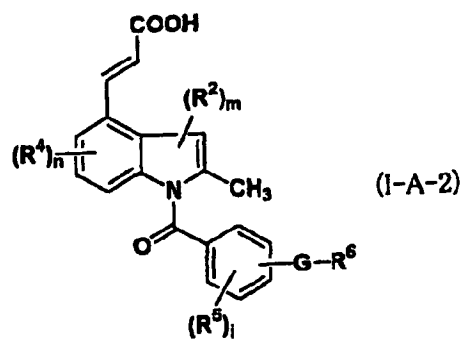
[0050] Unless otherwise specified, all isomers are included in the present invention. For example, alkyl, alkoxy and alkylene group includes straight or branched ones. In addition, isomers on double bond, ring, fused ring (E-, Z-, cis-, trans-isomer), isomers generated from asymmetric carbon atom(s) (R-, S-, α -, β -isomer, enantiomer, diastereomer), optically active isomers (D-, L-, d-, l-isomer), polar compounds generated by -chromatographic separation (more polar compound, less polar compound), equilibrium compounds, rotamer, mixtures thereof at voluntary ratios and racemic mixtures are also included in the present invention.

[0051] According to the present invention, unless otherwise indicated and as is apparent for those skilled in the art, symbol \diagup indicates that it is bound to the opposite side of the sheet (namely α -configuration), symbol \diagdown indicates that it is bound to the front side of the sheet (namely β -configuration), and symbol \diagup indicates that it is a mixture of α -configuration and β -configuration.

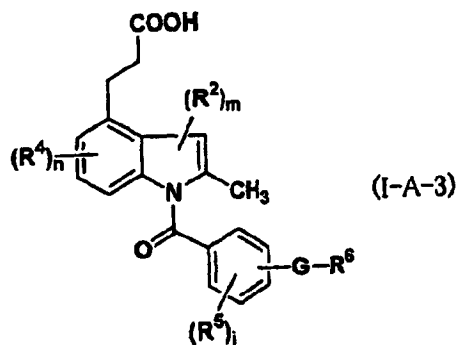
[0052] In the compounds represented by formula (I), as suitable compounds, a compound represented by formula (I-A-1);



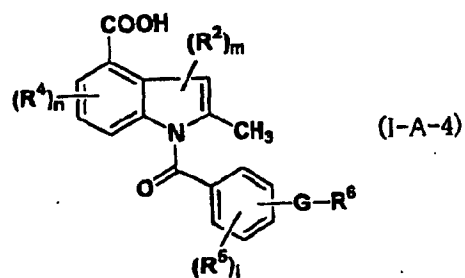
wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-A-2);



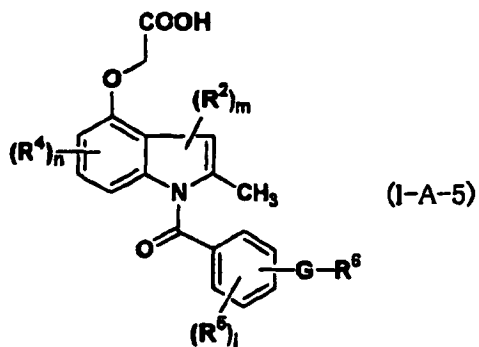
15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-A-3);



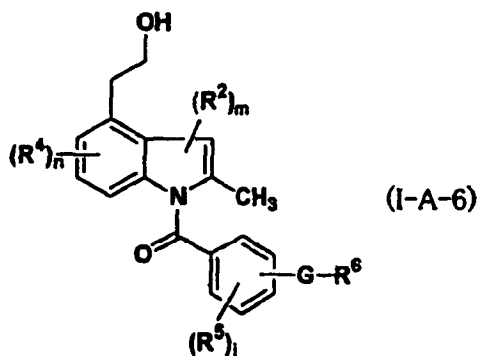
35 wherein all symbols represent the same meanings as the described above, a compound represented by formula
(I-A-4);



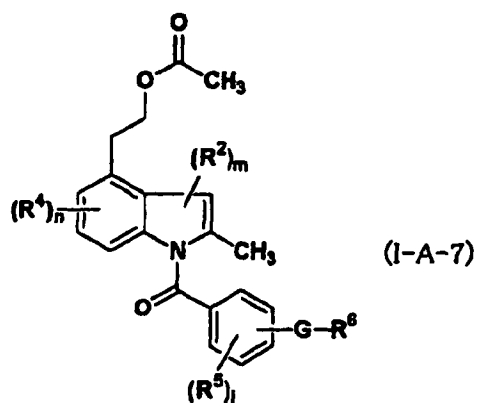
50 wherein all symbols represent the same meanings as the described above., a compound represented by formula
(I-A-5);



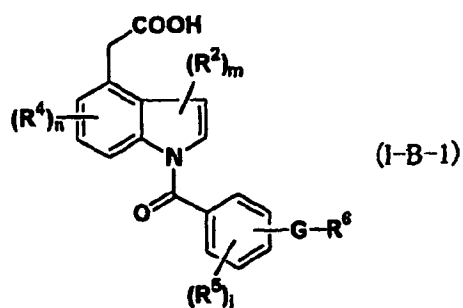
15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-A-6);



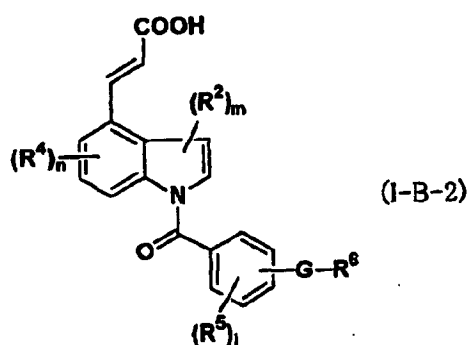
35 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-A-7);



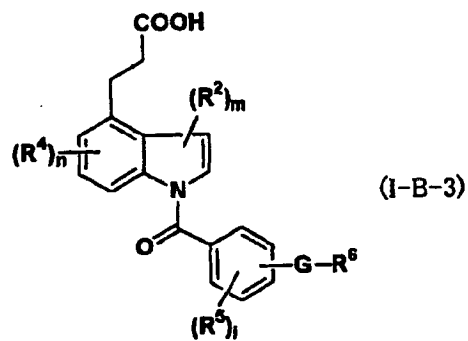
55 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-1);



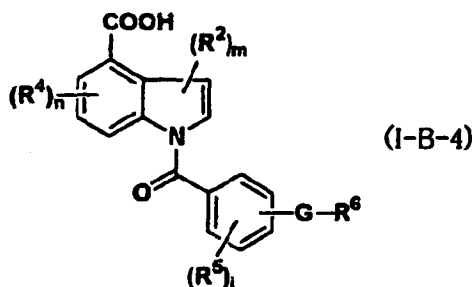
15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-2);



35 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-3);

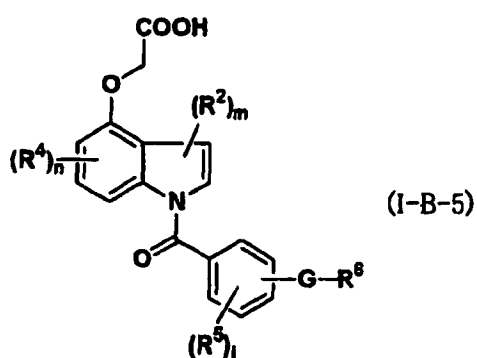


50 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-4);



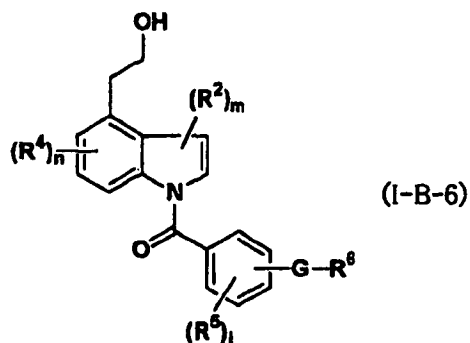
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wherein all symbols represent the same meanings as described above.,
a compound represented by formula (I-B-5):



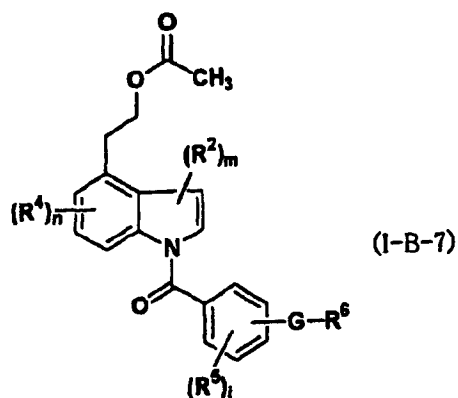
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wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-6);

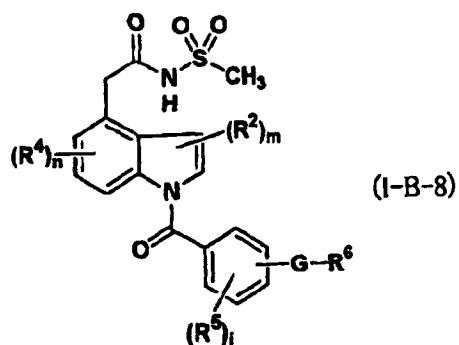


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wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-7);

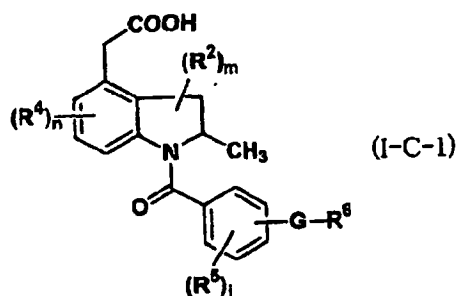


wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-B-8);



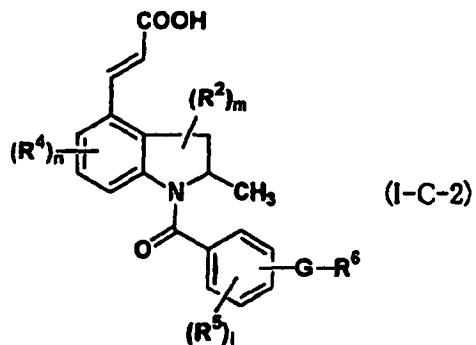
35

wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-1);

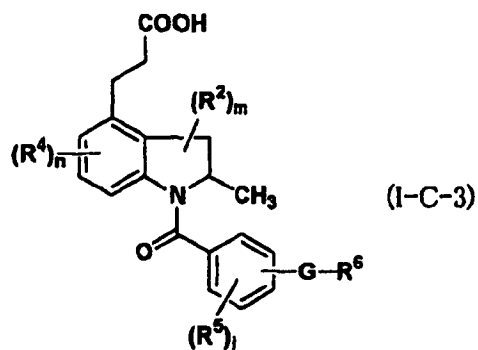


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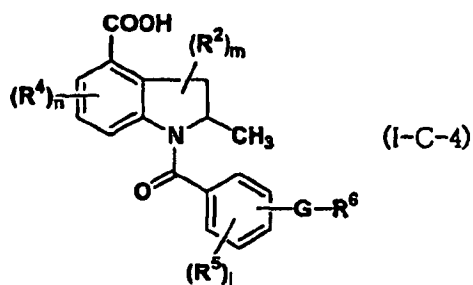
wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-2);



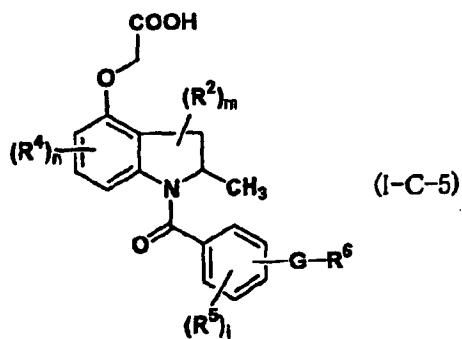
15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-3);



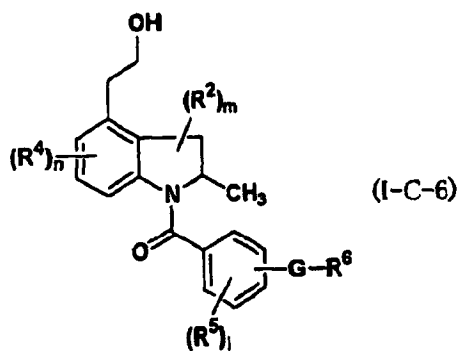
35 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-4);



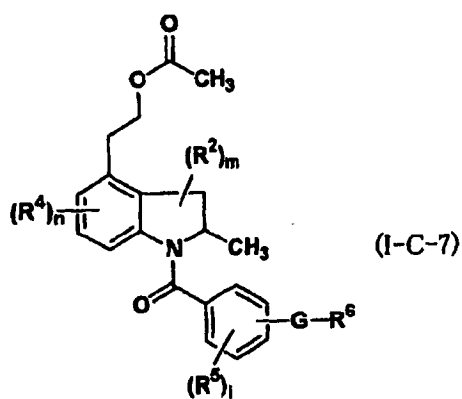
50 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-5);



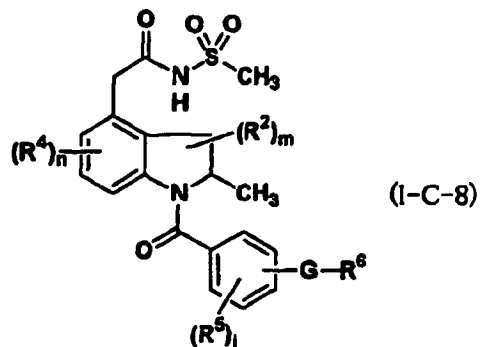
15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-6);



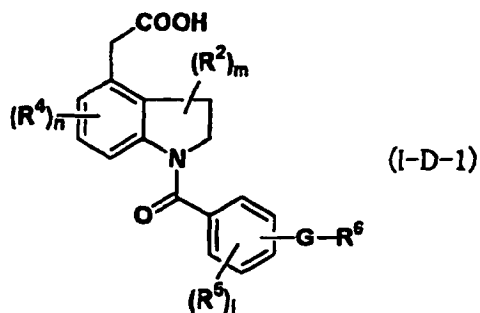
35 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-7);



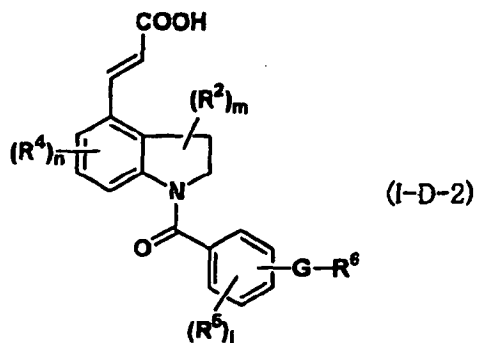
55 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-C-8);



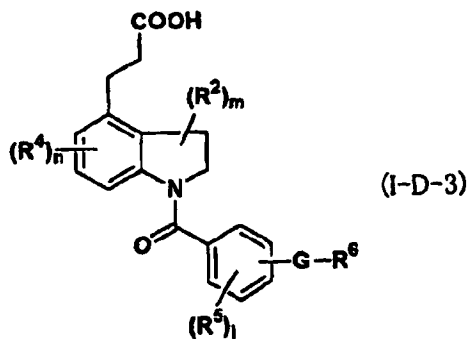
15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-1);



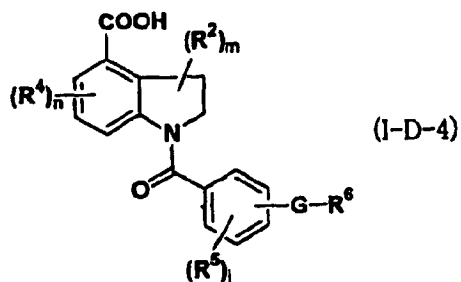
wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-2);



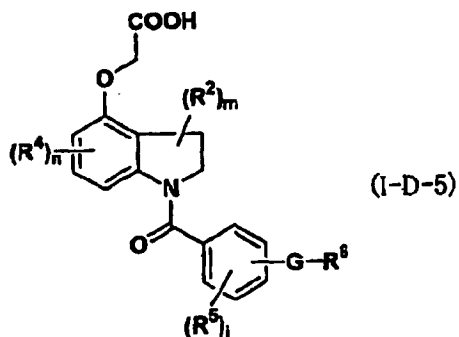
50 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-3);



15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-4);

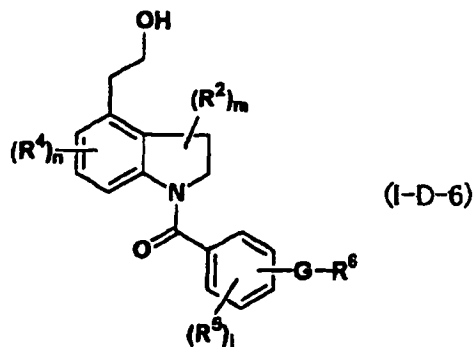


30 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-5);

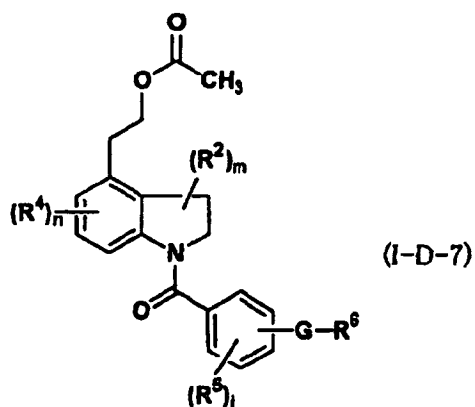


50 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-6);

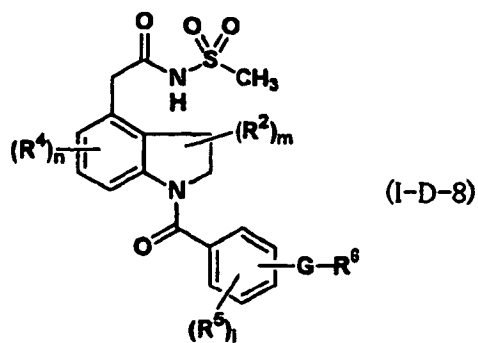
55



15 wherein all symbols represent the same meanings as the described above.,
a compound represented by formula (I-D-7);



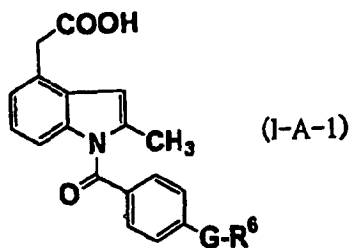
35 wherein all symbols represent the same meanings as the described above., or
a compound represented by formula (I-D-8);



wherein all symbols represent the same meanings as the described above is included.

[0053] In concrete compounds of the present invention, the compounds represented in the following table 1 to 54,
the compounds of examples, and non-toxic salts thereof are included.

Table 1



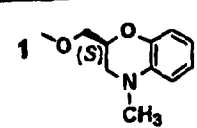
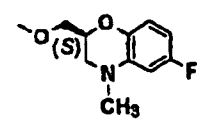
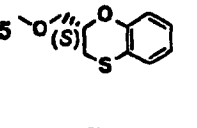
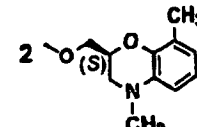
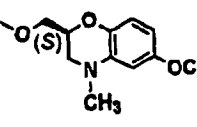
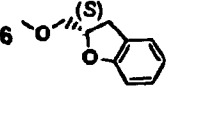
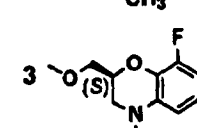
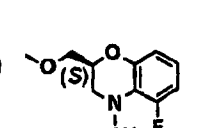
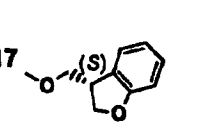
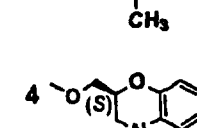
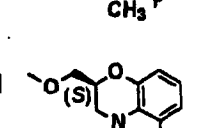
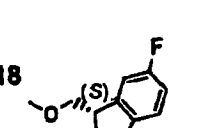
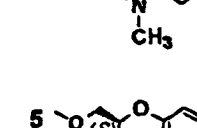
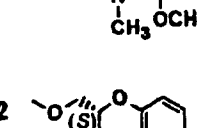
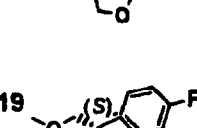
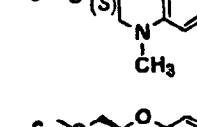
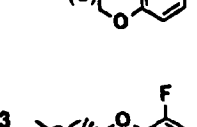
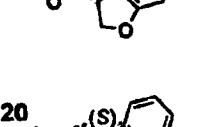
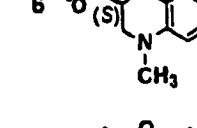
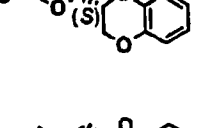
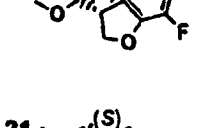
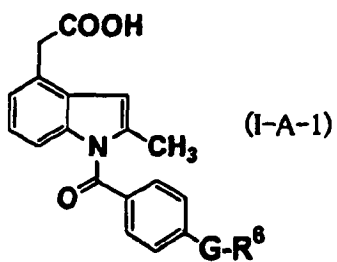
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2



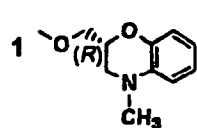
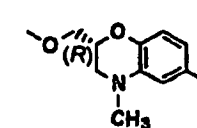
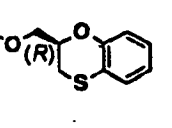
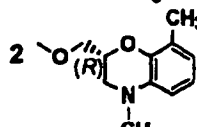
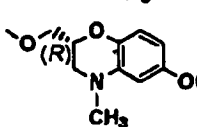
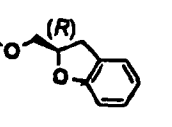
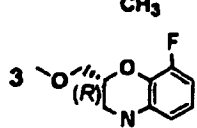
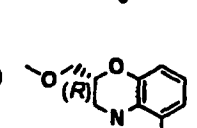
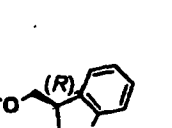
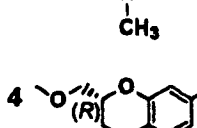
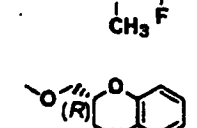
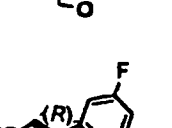
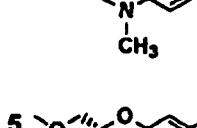
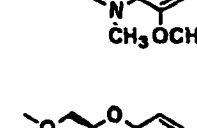
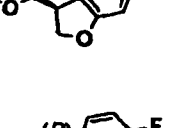
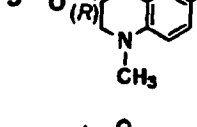
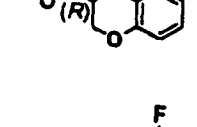
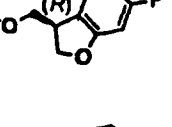
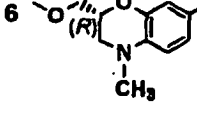
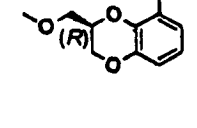
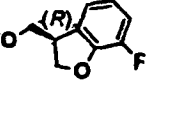
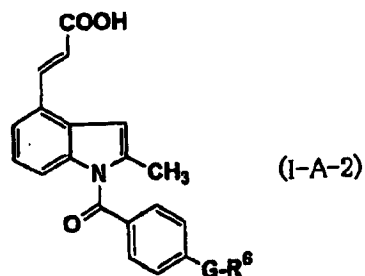
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3



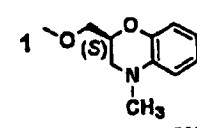
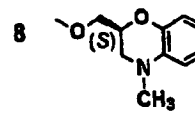
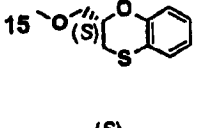
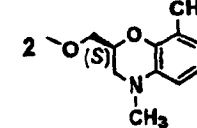
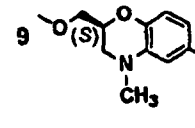
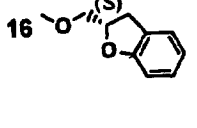
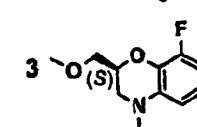
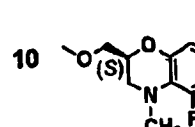
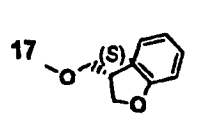
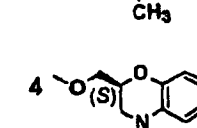
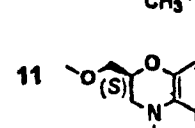
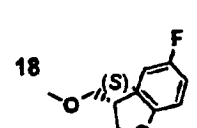
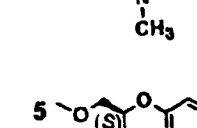
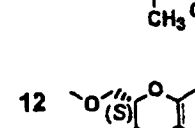
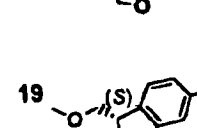
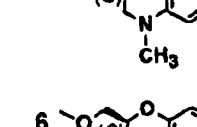
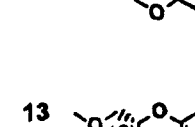
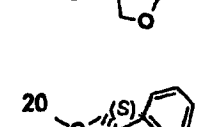
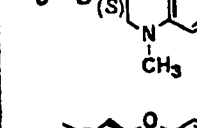
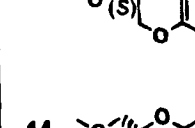
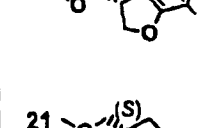
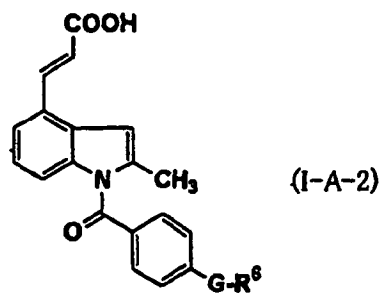
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

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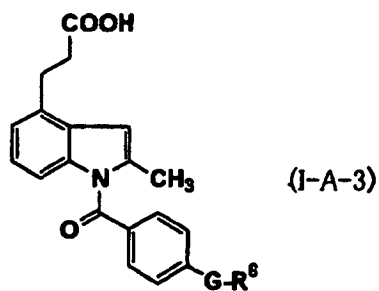
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40

45

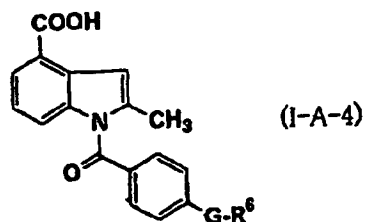
50

Table 6



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 7



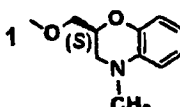
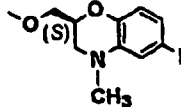
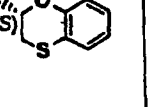
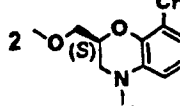
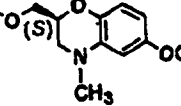
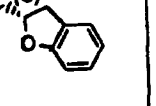
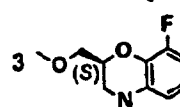
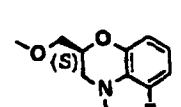
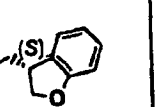
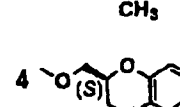
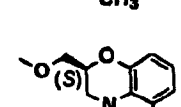
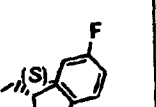
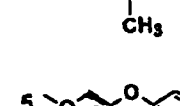
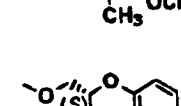
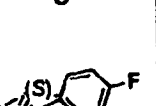
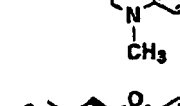
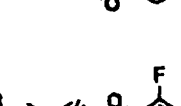
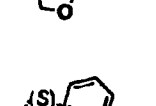
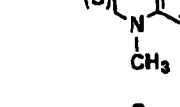
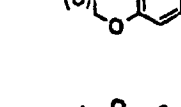
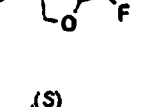
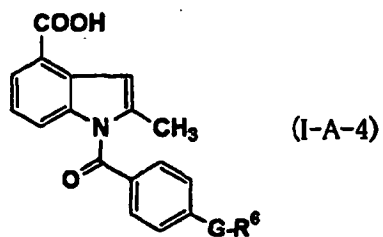
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 8



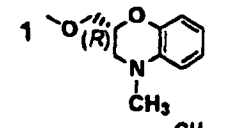
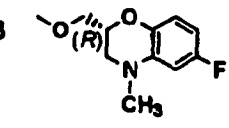
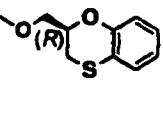
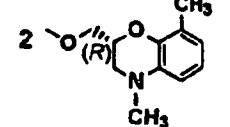
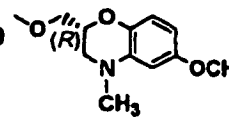
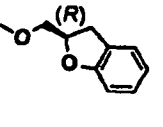
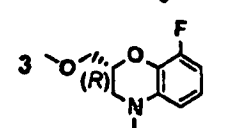
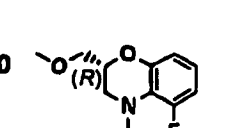
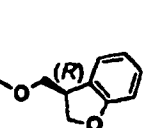
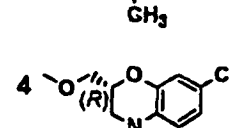
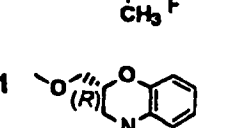
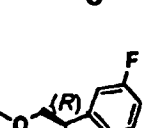
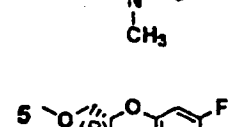
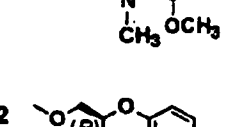
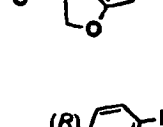
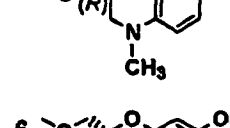
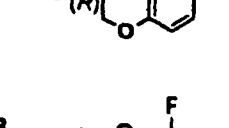
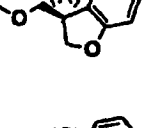
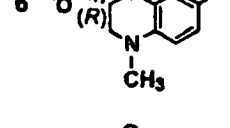
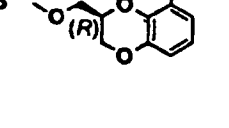
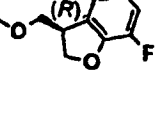
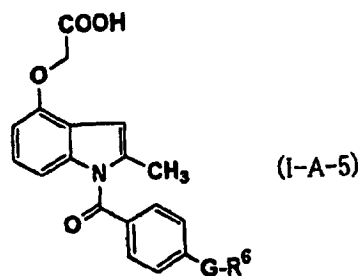
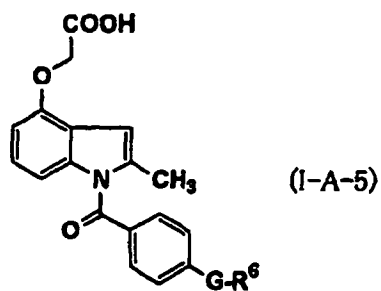
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 9



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 0



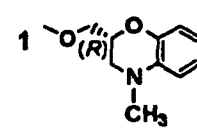
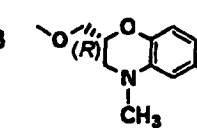
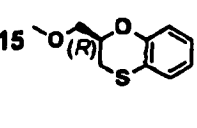
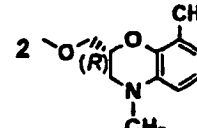
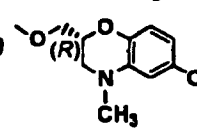
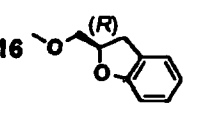
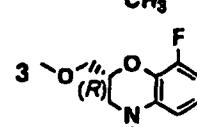
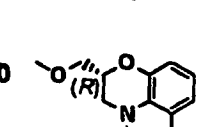
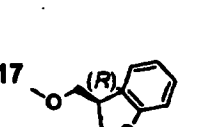
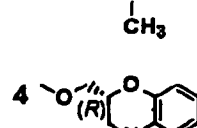
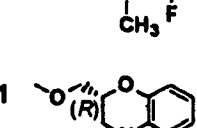
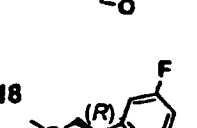
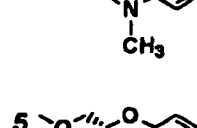
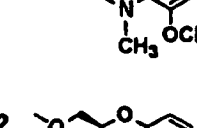
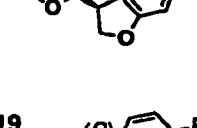
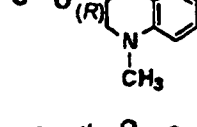
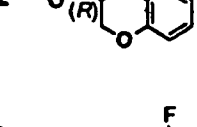
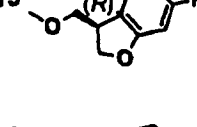
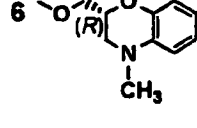
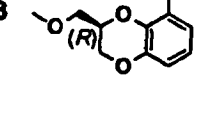
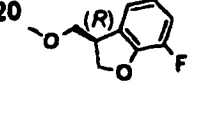
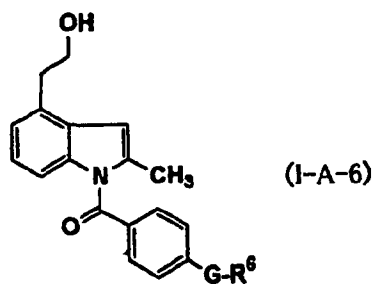
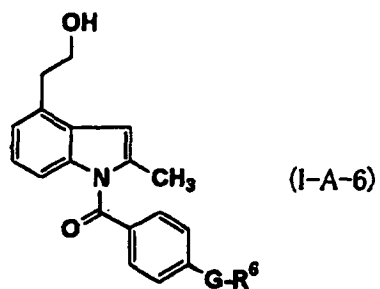
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 11



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 2



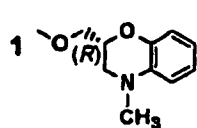
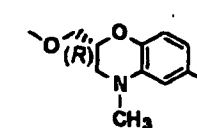
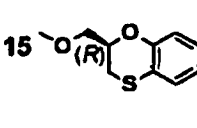
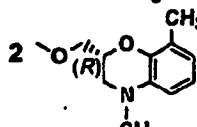
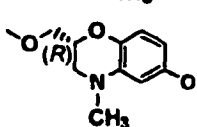
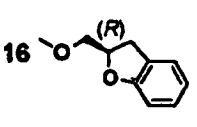
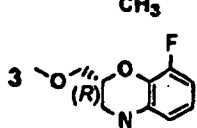
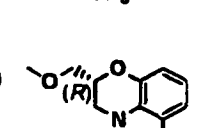
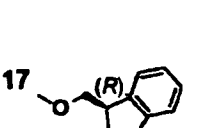
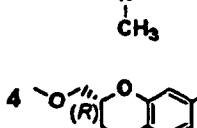
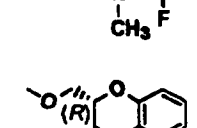
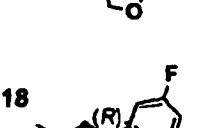
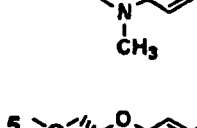
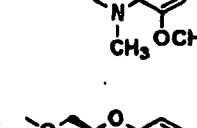
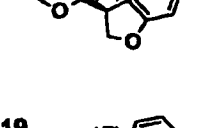
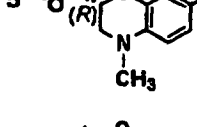
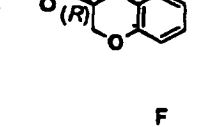
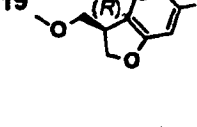
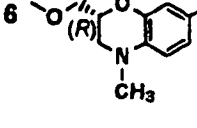
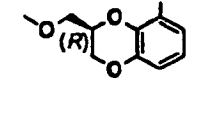
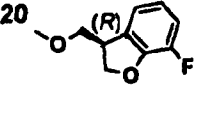
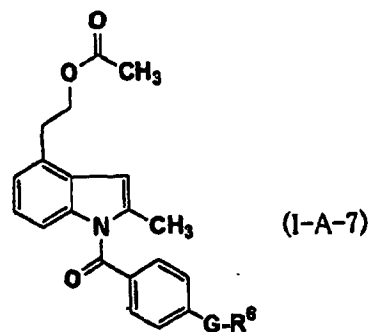
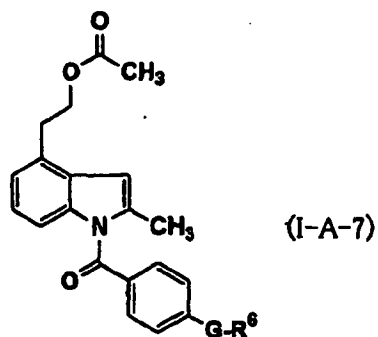
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 3



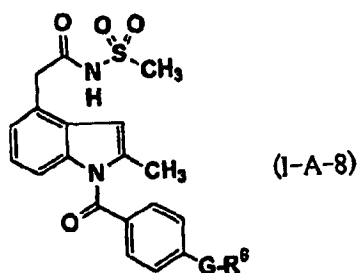
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 4



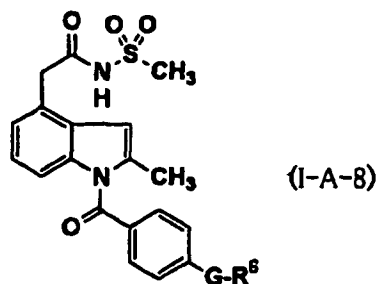
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 5



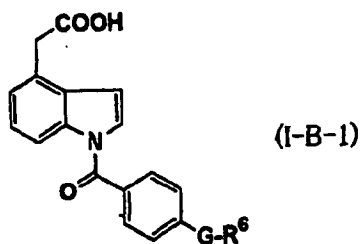
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 6



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1.7



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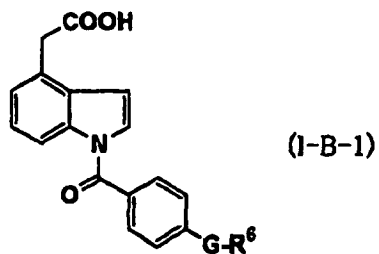
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 1 8



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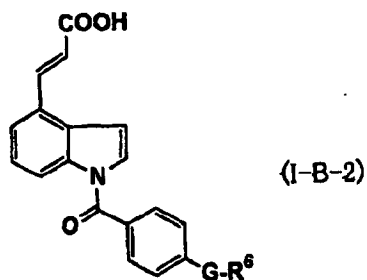
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 19

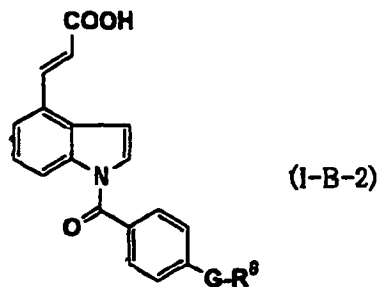


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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

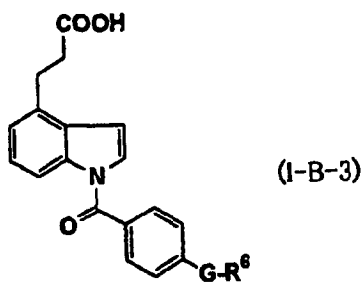
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Table 2 0



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 1



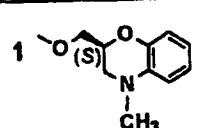
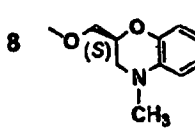
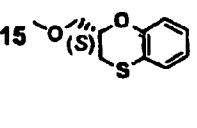
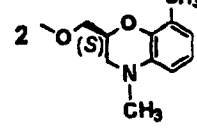
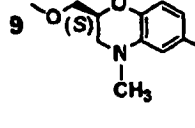
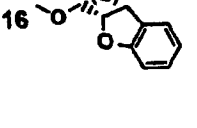
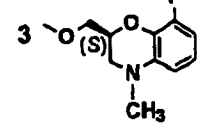
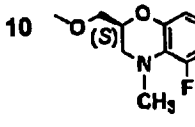
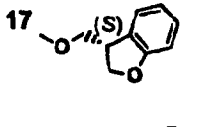
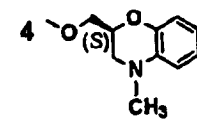
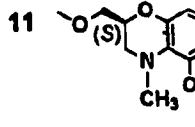
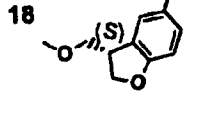
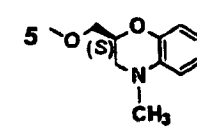
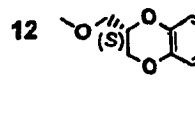
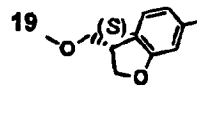
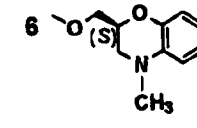
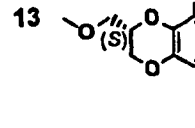
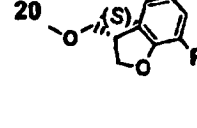
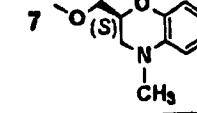
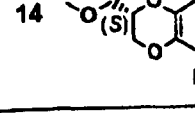
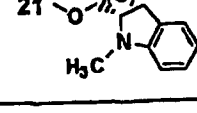
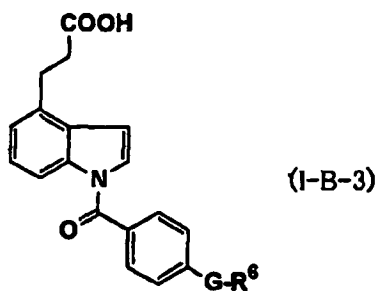
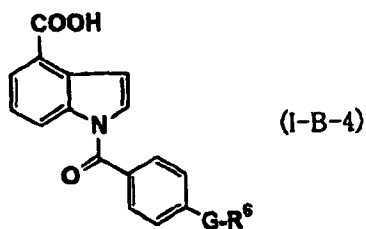
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 2



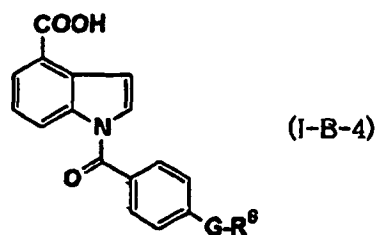
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 3



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 4



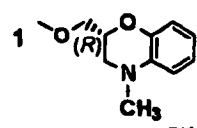
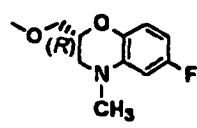
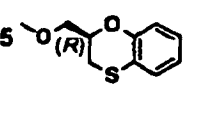
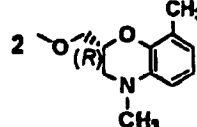
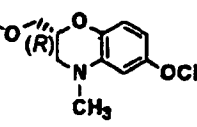
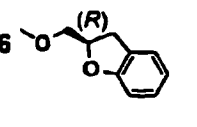
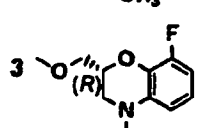
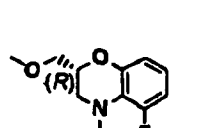
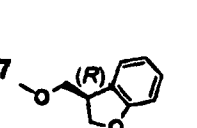
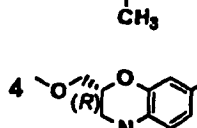
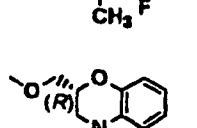
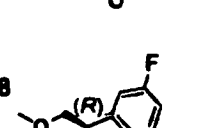
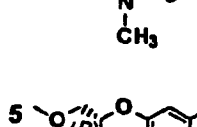
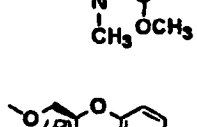
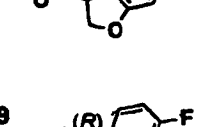
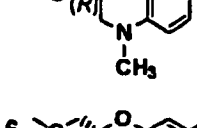
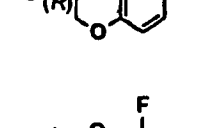
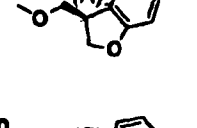
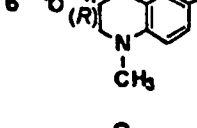
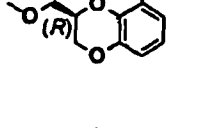
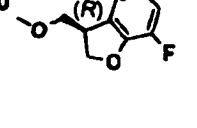
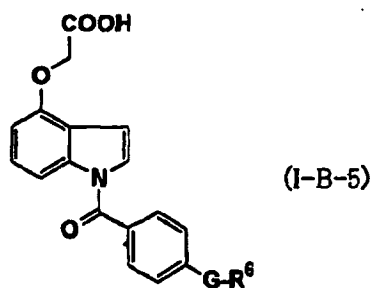
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 5



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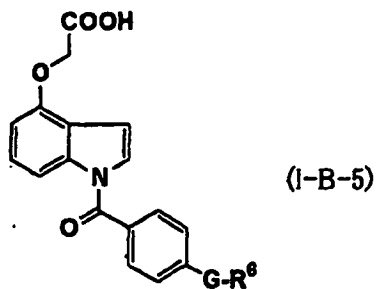
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 6

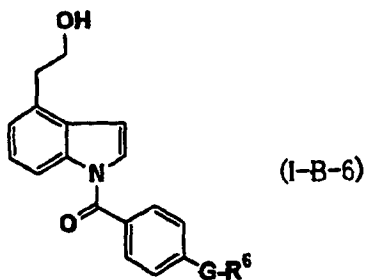


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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

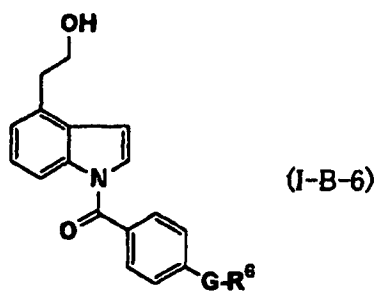
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Table 2 7



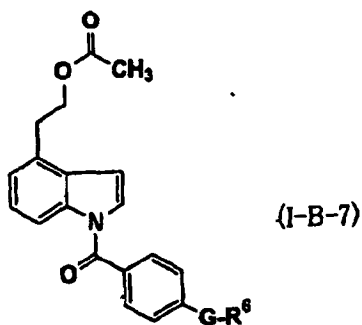
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 8



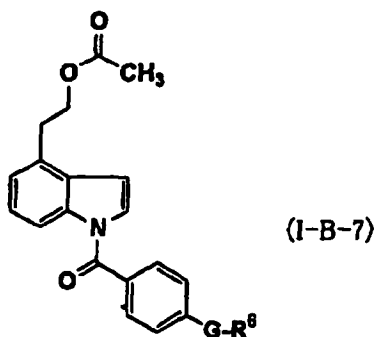
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 2 9



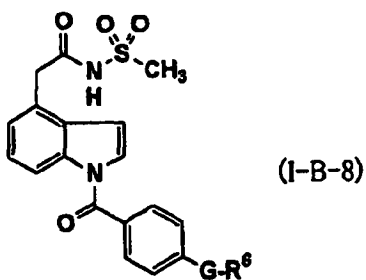
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 0



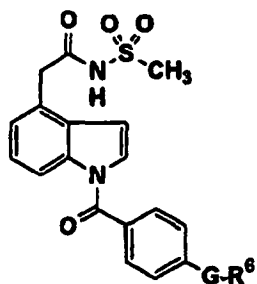
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 1



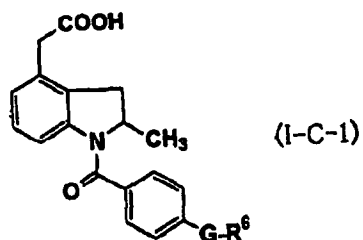
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 2



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 3



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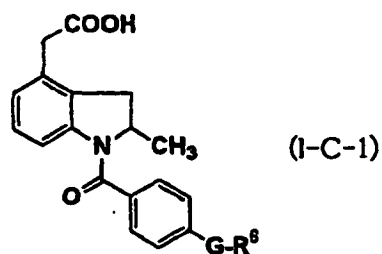
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 4



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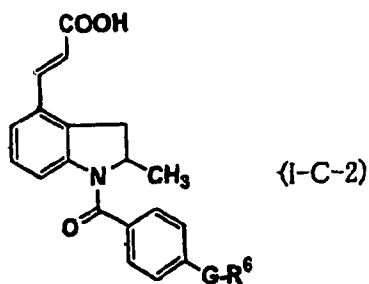
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 5



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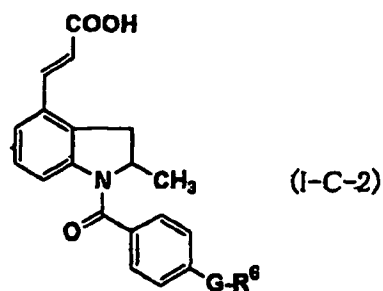
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 6

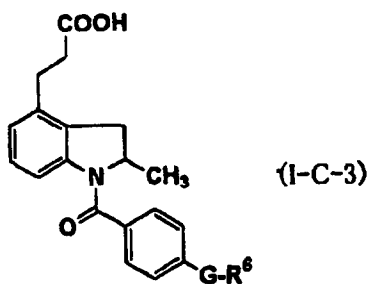


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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

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Table 3 7



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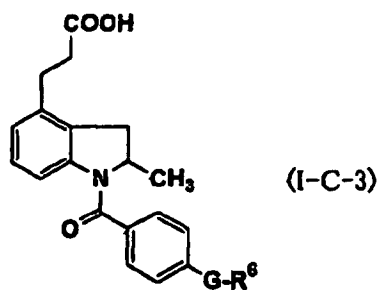
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 8



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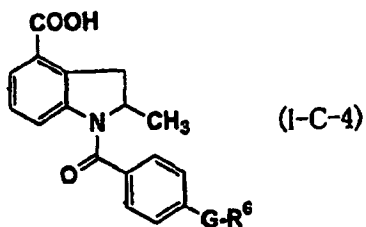
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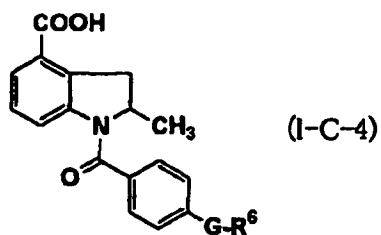
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 3 9



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 0



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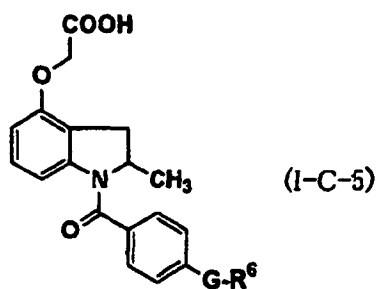
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 1



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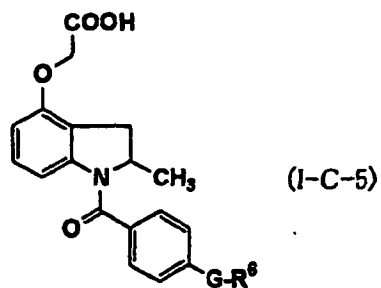
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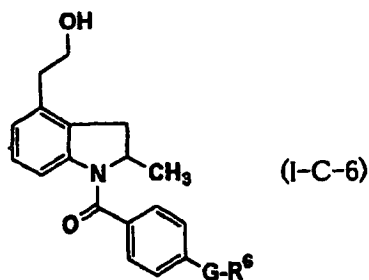
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 2



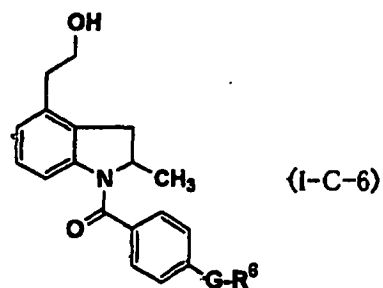
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
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4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 3



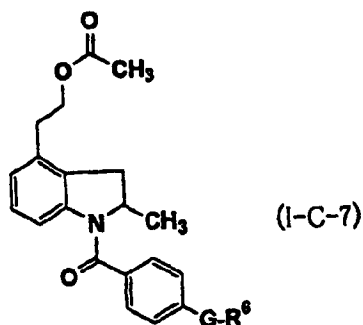
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 4



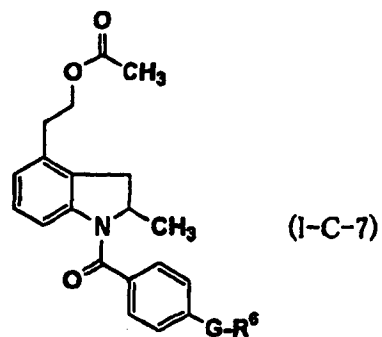
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 5



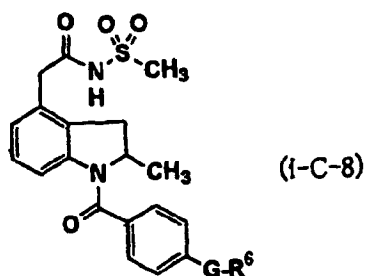
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 6



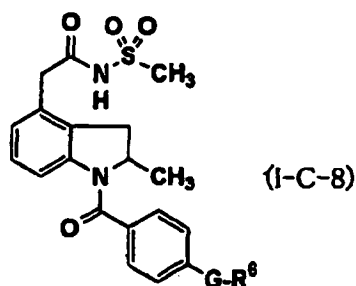
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 7



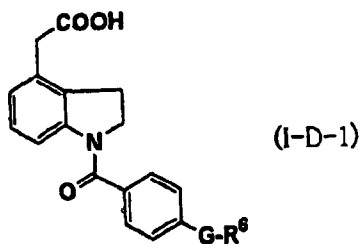
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 8



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 4 9



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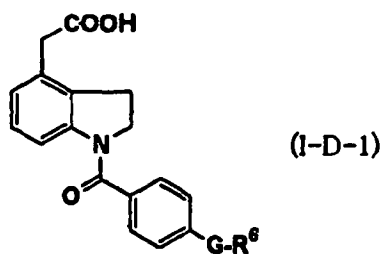
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 0



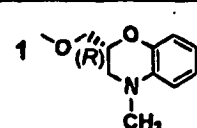
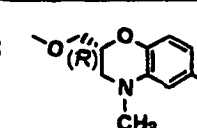
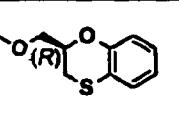
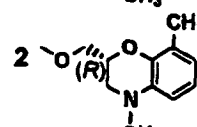
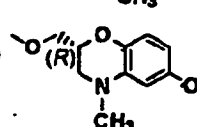
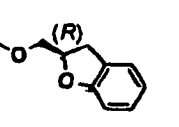
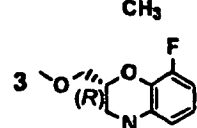
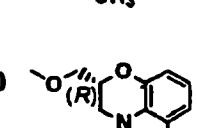
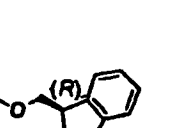
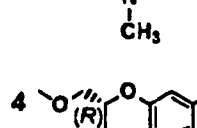
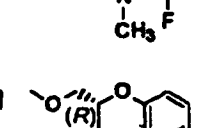
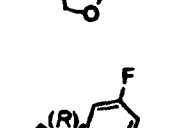
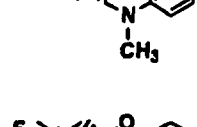
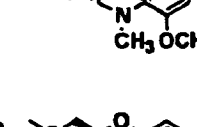
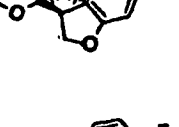
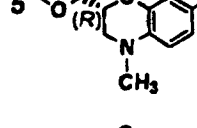
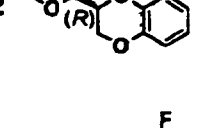
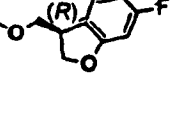
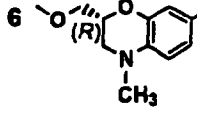
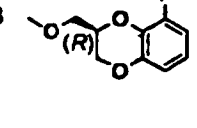
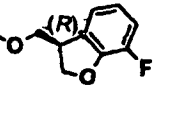
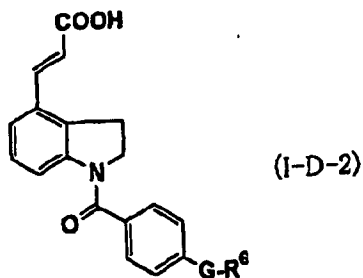
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 1



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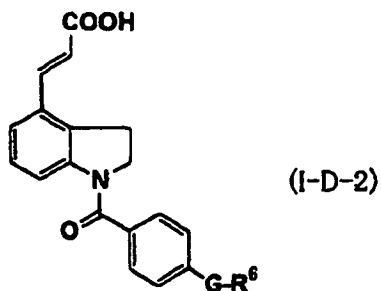
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No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
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6		13		20	
7		14		21	

Table 5 2



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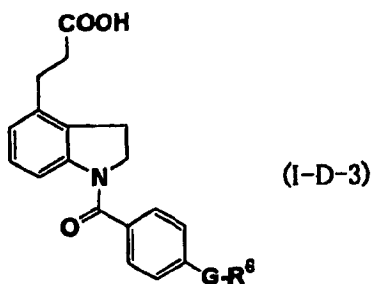
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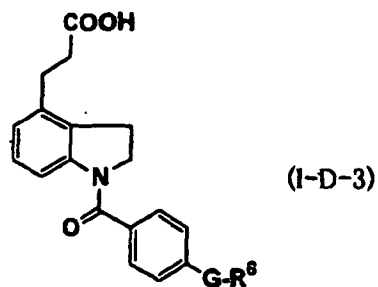
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 3



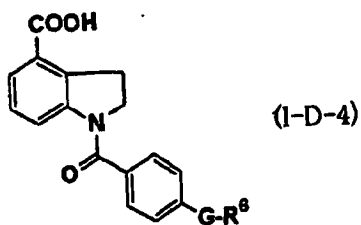
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 4



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 5



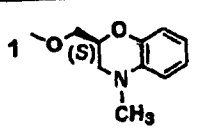
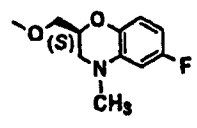
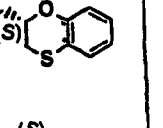
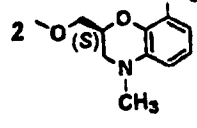
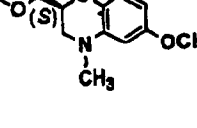
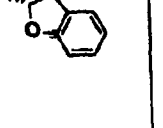
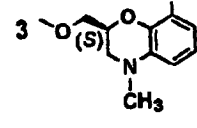
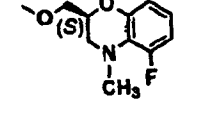
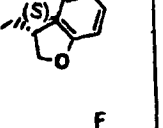
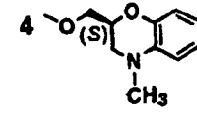
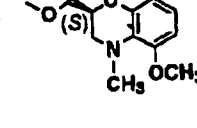
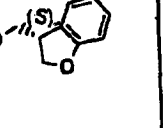
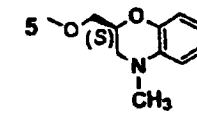
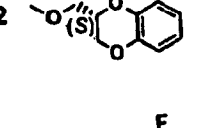
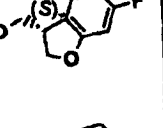
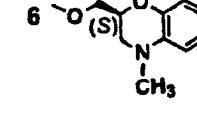
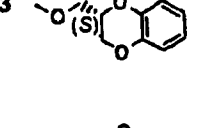
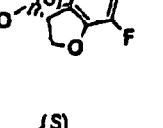
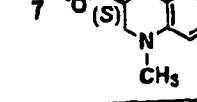
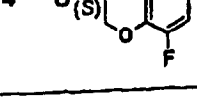
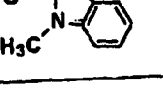
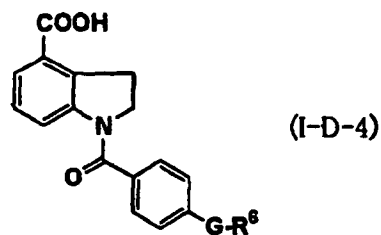
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 6



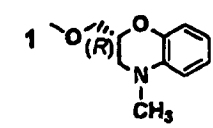
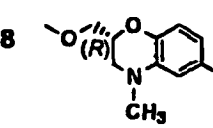
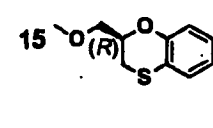
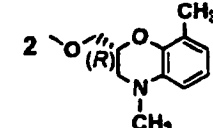
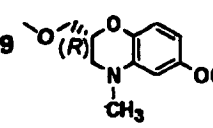
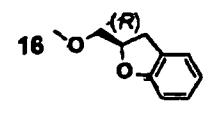
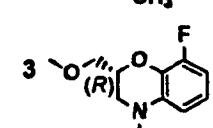
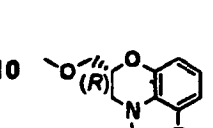
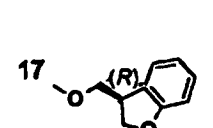
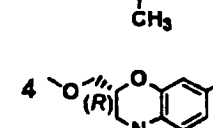
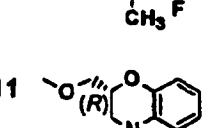

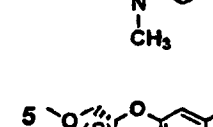
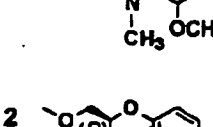
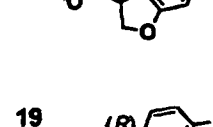
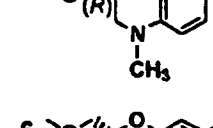
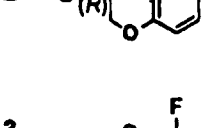
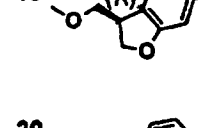
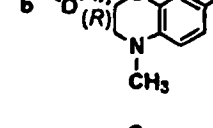
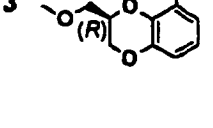
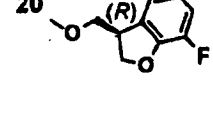
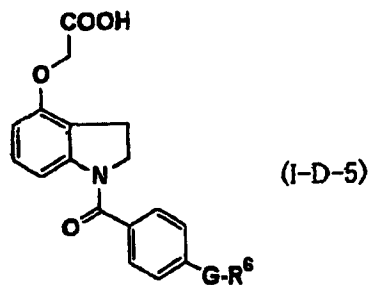
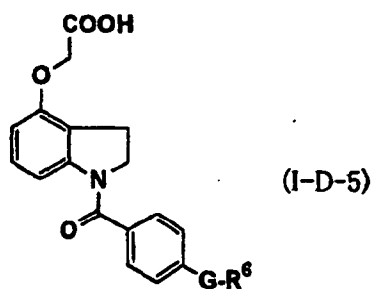
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 7



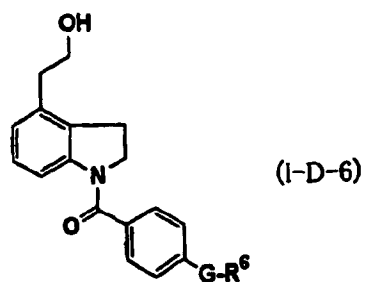
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2		9		16	
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4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 8



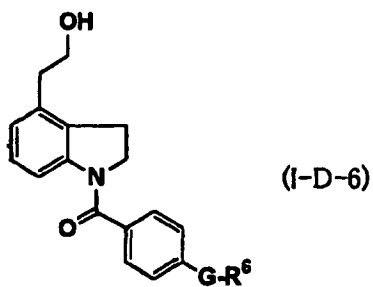
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 5 9



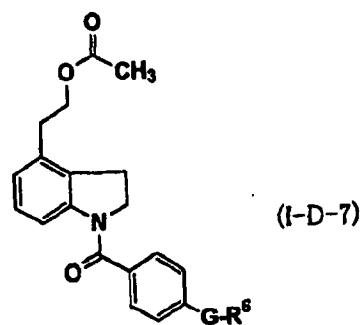
No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
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2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 6 0



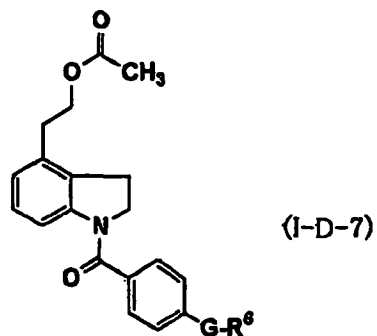
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2		9		16	
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5		12		19	
6		13		20	
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Table 6 1



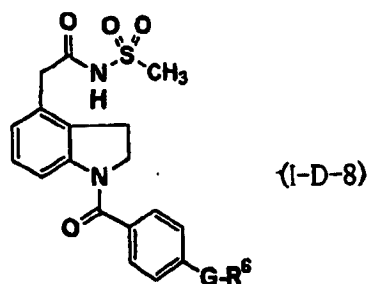
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5		12		19	
6		13		20	
7		14		21	

Table 6 2



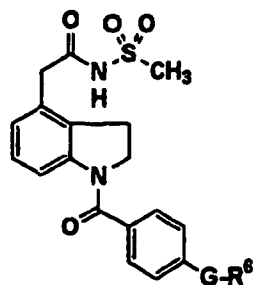
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1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 6 3



No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

Table 6 4



(I-D-8)

No.	-G-R ⁶	No.	-G-R ⁶	No.	-G-R ⁶
1		8		15	
2		9		16	
3		10		17	
4		11		18	
5		12		19	
6		13		20	
7		14		21	

[0054] PGD₂ receptor in this specification represents receptors that PGD₂ binds, not only the one found by present, but also the one that will be found in the future is included in the receptor. The desirable one is DP receptor or CRTH2 receptor, and more desirably DP receptor.

[Salts]

[0055] All non-toxic salts are included in the present invention.

[0056] The compounds represented by formula (I) in the present invention may be converted into the non-toxic salts by a well-known method. The non-toxic salts are suitable to be allowed in pharmacology, and water-soluble.

[0057] The non-toxic salts of the compounds represented by formula (I) in the present invention include, for example, alkali metal salts (potassium, sodium, lithium, etc.), alkaline earth metal salts (calcium, magnesium, etc.), ammonium salts (tetramethylammonium, tetrabutylammonium, etc.), organic amine salts (triethylamine, methylamine, dimethylamine, cyclopentylamine, benzylamine, phenethylamine, piperidine, monoethanolamine, diethanolamine, tris(hydroxymethyl)methylamine, lysine, arginine, N-methyl-D-glucamine, etc.), acid-addition salts (inorganic acid salts (hydrochloride, hydrobromate, hydroiodate, sulfate, phosphate, and nitrate, etc.), organic acid salts (acetate, trifluoroacetate, lactate, tartrate, oxalate, fumarate, maleate, benzoate, citrate, methane sulfonate, ethane sulfonate, benzene sulfonate, toluene sulfonate, isethionate, glucuronate, gluconate, etc.), etc.

[0058] In the non-toxic salts of the compounds represented by formula (I) in the present invention, solvates thereof, or solvates of alkali (earth) metal salts, ammonium salts, organic amine salts, and acid-addition salts of the above compound in the present invention, are included.

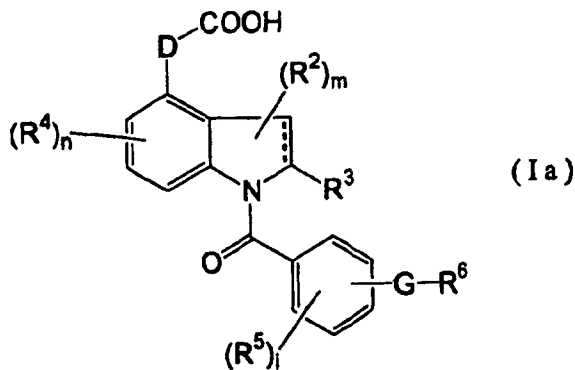
[0059] The solvates are preferably non-toxic and water-soluble. Appropriate solvates, for example, solvates such as water, alcohol solvents (ethanol, etc.), etc. are included.

[0060] All compounds represented by formula (I) or all non-toxic salts thereof are suitable. Concretely, the compounds described to example or non-toxic salts thereof are included.

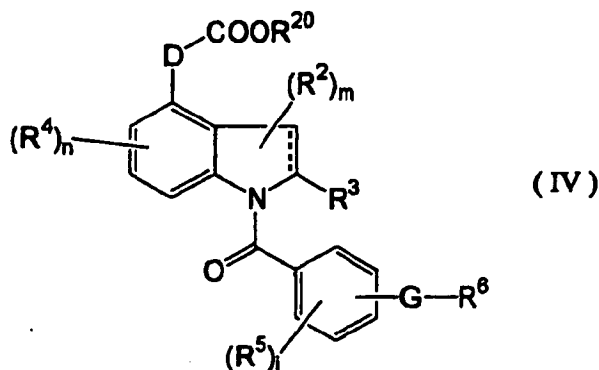
[Processes for the preparation of the compound of the present invention]

[0061] The compounds of the present invention represented by formula (I) may be prepared by the following processes and the processes represented in examples.

(a) Among the compounds represented by formula (I), a compound wherein R represents -COR¹ and R¹ is hydroxy, that is, a compound represented by formula (Ia):



wherein all symbols represent the same meanings as the described above may be prepared by subjecting a compound represented by formula (IV);

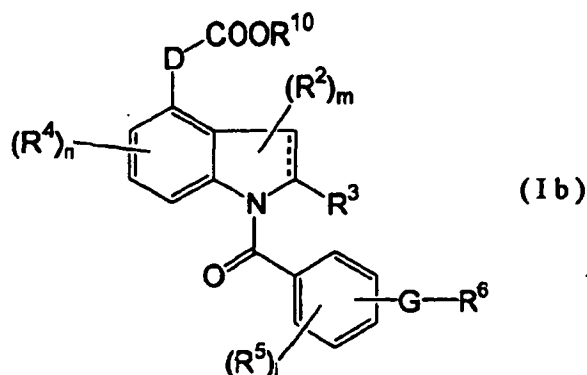


wherein R^{20} is an allyl or benzyl group and other symbols have the same meanings as the described above to deprotection reaction of allyl ester or benzyl ester.

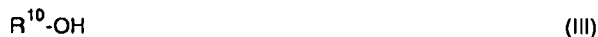
A deprotection reaction of allylic ester, which is well known, may be reacted at 0-50°C, for example, in an organic solvent (dichloromethane, dimethyl formamide, tetrahydrofuran, dioxane, ethyl acetate, and ethanol, etc.), under the absence or presence of a trap reagent (tributyltin hydroxide, dimedon, morpholine, pyrrolidine, and 2-ethylhexanoic acid, etc.) and/or an organic acid (acetate, etc.), using a metal complex (tetrakis(triphenylphosphine) palladium(0), bis(triphenylphosphine) palladium(II) dichloride, palladium acetate(II), and tris(triphenylphosphine)rhodium(I) chloride, etc.).

A deprotection reaction of benzyl ester, which is well known, may be carried out at 0-200°C, for example, in a solvent (ether (tetrahydrofuran, dioxane, dimethoxyethane, and diethyl ether, etc.), alcohols (methanol and ethanol, etc.), benzenes (benzene and toluene, etc.), ketones (acetone and methylethylketone, etc.), nitriles (acetonitrile etc.), amides (dimethylformamide etc.), water, ethyl acetate, acetate, or two or more mixed solvent(s) thereof, etc.), under the presence of a catalyst (palladium-carbon, palladium black, hydroxide palladium, platinum oxide, and raney nickel, etc.), atmospheric or pressurized hydrogen atmosphere, or formate ammonium.

(b) Among the compounds represented by formula (I), a compound wherein R represents -COR¹ and R¹ is C1-6 alkoxy, that is, a compound represented by formula (Ib):



wherein R^{10} represents C1-6 alkyl and other all symbols have the same meanings as the described above can be prepared by subjecting a compound represented by formula (Ia) with a compound represented by formula (III):



wherein all symbols have the same meanings as the described above to esterification reaction, followed by optionally a deprotection reaction.

As esterification reactions that are well-known, for example,

- (1) a method using acyl halide,
 (2) a method using mixed acid anhydride, and
 (3) a method using a condensing agent are included.

These methods are concretely explained as follows,

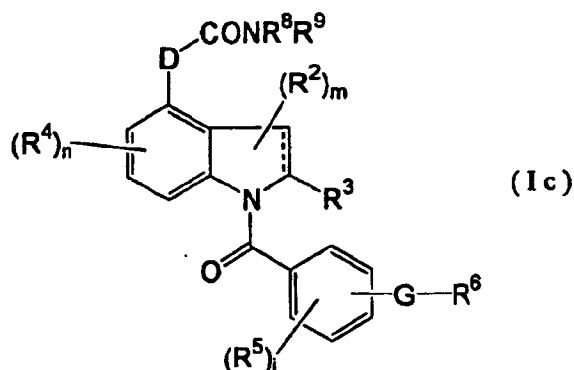
(1) The method using acyl halide may be carried out, for example, by reacting carboxylic acid with acyl halide (oxalyl chloride or thionyl chloride, etc.) in an organic solvent (chloroform, methylene chloride, diethyl ether or tetrahydrofuran, etc.) or without a solvent at 20°C to reflux temperature and then reacting the obtained acyl halide with alcohol in an inactive organic solvent (chloroform, methylene chloride, diethyl ether or tetrahydrofuran, etc.), under the presence of a tertiary amine (pyridine, triethyl amine, dimethyl aniline, dimethylaminopyridine or diisopropylethylamine, etc.) at 0-40°C. The method may be carried out by reacting with acyl halide in an organic solvent (dioxane, tetrahydrofuran) using an alkaline solution (sodium bicarbonate, sodium hydroxide, etc.) at 0-40°C.

(2) The method using mixed acid anhydride may be carried out, for example, by reacting carboxylic acid with acyl halide (epivaloyl chloride, tosyl chloride, mesyl chloride, etc.), or an acid derivative (ethyl chloroformate or isobutyl chloroformate, etc.) in an organic solvent (chloroform, methylene chloride, diethyl ether, tetrahydrofuran, etc.) or without a solvent, under the presence of a tertiary amine (pyridine, triethylamine, dimethylaniline, dimethylaminopyridine or diisopropylethylamine, etc.) at 0-40°C, and then reacting the obtained mixed acid anhydride with alcohol in an organic solvent (chloroform, methylene chloride, diethyl ether or tetrahydrofuran, etc.) at 0-40°C.

(3) The method using a condensing agent may be carried out, for example, by reacting carboxylic acid with alcohol in an organic solvent (chloroform, methylene chloride, dimethylformamide, diethyl ether or tetrahydrofuran, etc.), these mixed solvents, or without a solvent, under the presence or absence of a tertiary amine (pyridine, triethylamine, dimethylaniline or dimethylaminopyridine, etc.), using a condensing agent (1, 3-dicyclohexyl carbodiimide (DCC), 1-ethyl-3-(dimethylamino)propyl carbodiimide (EDC), 1, 1'-carbodiimidazole (CDI), 2-chloro-1-methylpyridinium iodide, methanesulphonyloxybenzotriazole, 3-methyl-2-fluoropyridinium tosylate methyl or 1-propanephosphonic acid cyclic anhydride; PPA, etc.), with or without 1-hydroxybenzotriazole (HOBt), at 0-40°C.

It is suitable that the reaction described in (1), (2) and (3) may be carried out under an inert gas (argon and nitrogen, etc.) and water free condition.

(c) Among the compounds represented by formula (I), a compound wherein R represents -COR⁸ and R¹ represents -NR⁸R⁹, that is, the compound represented by formula (Ic)



wherein all symbols represent the same meaning as the described above may be prepared by subjecting the compound represented by formula (Ia) and a compound represented by formula (II)



wherein all symbols represent the same meaning as the described above to amidation reaction, and further, to the deprotection of the protecting group optionally.

As the amidation reactions that are well-known, for example,

- (1) a method using acyl halide,
- (2) a method using mixed acid anhydride, and
- (3) a method using a condensing agent are included.

These methods are concretely explained as follows.

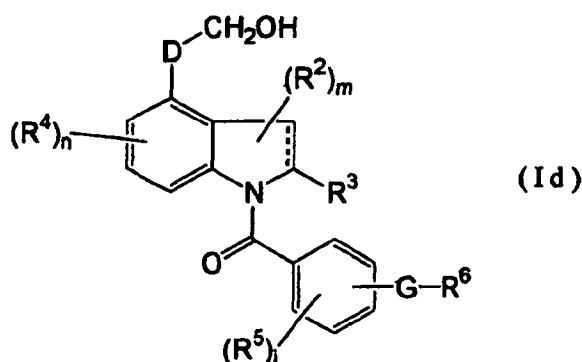
(1) The method using an acyl halide may be carried out, for example, by reacting carboxylic acid with acyl halide (oxalyl chloride or thionyl chloride, etc.) in an organic solvent (chloroform, methylene chloride, diethyl ether or tetrahydrofuran, etc.) or without a solvent at -20°C to reflux temperature and then reacting the obtained acyl halide with amine in an inactive organic solvent (chloroform, methylene chloride, diethyl ether, tetrahydrofuran, ethyl acetate, or acetonitrile, etc.), under the presence of tertiary amine (pyridine, triethylamine, dimethylaniline, dimethylaminopyridine or diisopropylethylamine, etc.) at 0-40°C. The method may be carried out by reacting with the acyl halide in an organic solvent (dioxane, tetrahydrofuran, toluene, or dimethoxyethane, etc.) using an alkaline solution (sodium bicarbonate, sodium hydroxide, etc.) at 0-40°C.

(2) The method using a mixed acid anhydride may be carried out, for example, by reacting carboxylic acid with acyl halide (pivaloyl chloride, tosyl chloride, mesyl chloride, etc.), or an acid derivative (ethyl chloroformate or isobutyl chloroformate, etc.) in an organic solvent (chloroform, methylene chloride, diethyl ether, tetrahydrofuran, etc.) or without a solvent, under the presence of a tertiary amine (pyridine, triethylamine, dimethylaniline, dimethylaminopyridine or diisopropylethylamine, etc.) at 0-40°C, and then reacting the obtained mixed acid anhydride with amine in an organic solvent (chloroform, methylene chloride, diethyl ether or tetrahydrofuran, etc.) at 0-40°C.

(3) The method using a condensing agent may be carried out, for example, by reacting carboxylic acid with amine in an organic solvent (chloroform, methylene chloride, dimethylformamide, diethyl ether or tetrahydrofuran, etc.) or without a solvent, under the presence or absence of a tertiary amine (pyridine, triethylamine, dimethylaniline or dimethylaminopyridine, etc.), using a condensing agent (1, 3-dicyclohexyl carbodiimide (DCC), 1-ethyl-3-[3-(dimethylamino)propyl] carbodiimide (EDC), 1, 1'-carbodiimidazole (CDI), 2-chloro-1-methylpyridinium iodide, methanesulphonyloxybenzotriazole, or 1-propanephosphonic acid cyclic anhydride; PPA, etc.), with or without 1-hydroxybenzotriazole (HOBt), at 0-40°C.

It is suitable that the reaction described in (1), (2) and (3) may be carried out under an inert gas (argon and nitrogen, etc.) and water free condition.

(d) Among the compounds represented by formula (I), a compound wherein R represents -CH₂OR⁰ and R⁰ is a hydrogen atom, that is, a compound represented by formula (Id)

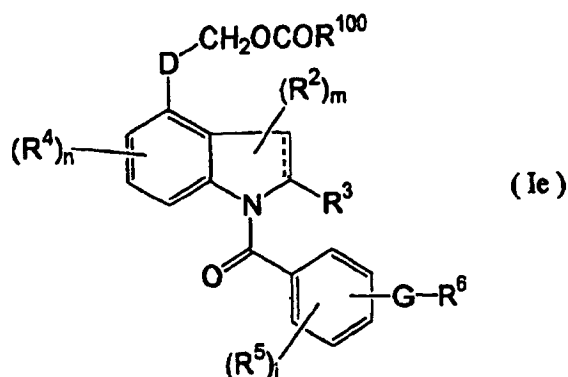


wherein all symbols represent the same meaning as the described above may be prepared by subjecting the compound represented by formula (Ia) to the reductive reaction, and then, the deprotection of the protecting group optionally.

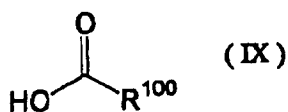
The reductive reaction, which is well-known, may be carried out at 0-80°C, for example, in an organic solvent (tetrahydrofuran etc.) using an borane complex (borane-tetrahydrofuran complex, and borane-dimethylsulfide

complex, etc.) or by reacting carboxylic acid with the acid derivative chloro ethyl formate and chloro formate iso-butyl, etc.) at 0-40°C in an inert organic solvent (chloroform, methylene chloride, diethyl ether, and tetrahydrofuran, etc.) or without a solvent under the presence of tertiary amine (pyridine, triethylamine, dimethyl aniline, and dimethylaminopyridine, etc.), and further, reacting the obtained mixed acid anhydride at 0-40°C in an inert organic solvent (chloroform, methylene chloride, diethyl ether, and tetrahydrofuran, etc.) using a reducing agent (sodium borohydride etc.).

(e) Among the compounds represented by formula (I), a compound wherein R represents -CH₂OR⁰ and R⁰ represents C2-6 acyl group, that is, a compound represented by formula (Ie)



wherein R¹⁰⁰ represents C1-5 alkyl group, other symbols represent the same meaning as the described above may be prepared by subjecting the compound represented by formula (Id) and a compound represented by formula (IX)



wherein all symbols represent the same meaning as the described above to the esterification reaction.

[0062] As esterification reactions that are well-known, for example,

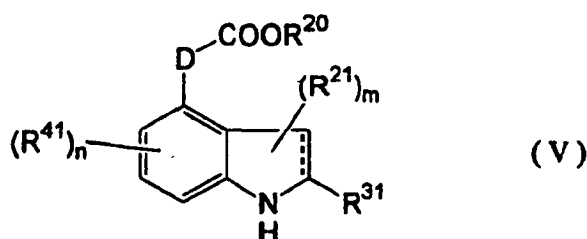
- (1) a method using acyl halide,
- (2) a method using mixed acid anhydride,
- (3) a method using a condensing agent, and
- (4) a method using acid anhydride are included.

[0063] The methods described in (1) to (3) are carried out by the method of the above esterification reaction.

[0064] The method described in (4) using acid anhydride is carried out by subjecting acid anhydride to react with alcohol at 0-40°C, for example, in organic solvent (chloroform, dichloromethane, diethyl ether, and tetrahydrofuran, etc.) or without solvents, under the presence of tertiary amine (pyridine, triethylamine, dimethylaniline, and dimethylaminopyridine, etc.).

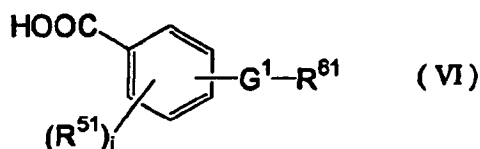
[0065] It is suitable that the reaction described in (1), (2), (3), and (4) may be carried out under an inert gas (argon and nitrogen, etc.) and water free condition.

[0066] A compound represented by formula (IV) may be prepared by subjecting a compound represented by formula (V);



wherein R²¹, R³¹, and R⁴¹ represent the same meaning as R², R³, and R⁴, respectively; however, they are protected by the protecting group when they represent amino or hydroxyl group, and other symbols represent the same meaning as the described above and a compound represented by formula (VI);

15



wherein R⁵¹ represents the same meaning as R⁵; however, they are protected by the protecting group when they represent amino or hydroxyl group, and G¹ and R⁶¹ represent the same meaning as G and R⁶, respectively; however, they are protected by the protecting group when they contain amino or hydroxyl group to the amidification reaction, and further, the deprotection reaction optionally. The amidification reaction is carried out by the above method.

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[0067] Deprotection reaction of the protecting group may be carried out by the following methods.

[0068] The deprotection reactions of the protecting groups of hydroxyl or amino group are known well, for example,

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- (1) alkaline hydrolysis,
 - (2) a deprotection reaction under acid condition,
 - (3) a deprotection reaction by hydrolysis, and
 - (4) a deprotection reaction of silyl group, etc. are included.
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[0069] These methods are concretely explained as follows,

(1) The deprotection reaction by alkaline hydrolysis may be carried out at 0-40°C, for example, in an organic solvent (methanol, tetrahydrofuran, dioxane or these mixed solvents, etc.), using an alkali metal (sodium hydroxide, potassium hydroxide, and lithium hydroxide, etc.), an alkaline earth metal (barium hydroxide and calcium hydroxide, etc.), a carbonate (sodium carbonate and potassium carbonate, etc.), the solution, or these compounds.

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(2) The deprotection reaction under acid condition may be carried out at 0-100°C, for example, under the presence or absence of an organic solvent (methylene chloride, chloroform, dioxane, ethyl acetate, anisole, methanol, ethanol, and isopropyl alcohol, etc.), or in the solution, an organic acid (acetate, trifluoroacetic acid, and methanesulfonic acid, etc.), an inorganic acid (hydrochloric acid and sulfate, etc.), or these compounds (hydrogen bromide/acetate etc.).

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(3) The deprotection reaction by hydrolysis may be carried out at 0-200°C, for example, in a solvent (ethers(tetrahydrofuran, dioxane, dimethoxyethane, and diethyl ether, etc.), alcohol (methanol and ethanol, etc.), benzenes (benzene and toluene, etc.), ketone (acetone and methyl ethyl ketone, etc.), nitriles (acetonitrile etc.), amide (dimethyl formamide etc.), water, ethyl acetate, acetate, or two or more mixed solvent(s) thereof, etc.), under the presence of a catalyst (palladium-carbon, palladium black, hydroxide palladium, platinum oxide, and raney nickel, etc.), atmospheric or pressurized hydrogen atmosphere, or formate ammonium.

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(4) The deprotection reaction of silyl group may be carried out at 0-40°C, for example, in water and an organic solvent (tetrahydrofuran and acetonitrile, etc.) that can be mixed, using tetrabutylammoniumfluoride.

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[0070] As protecting groups of hydroxyl group, for example, methoxymethyl, 2-tetrahydropyranyl, tert-butyl dimethylsilyl, tert-butyl diphenyl silyl, acetyl, benzyl, and 4-methoxybenzyl group, etc. are included.

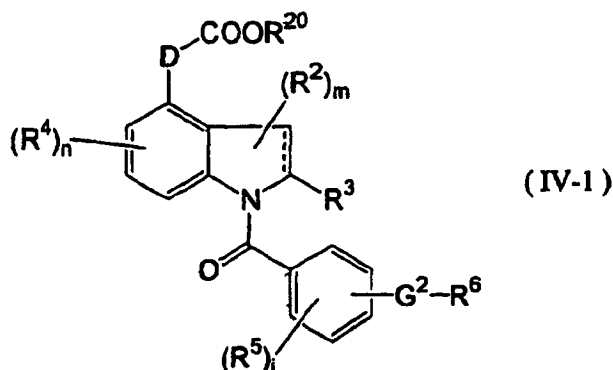
[0071] As protecting groups of amino group, for example, benzyloxycarbonyl, t-butoxycarbonyl, trifluoroacetyl, and

9-fluorenylmethoxycarbonyl group, etc. are included.

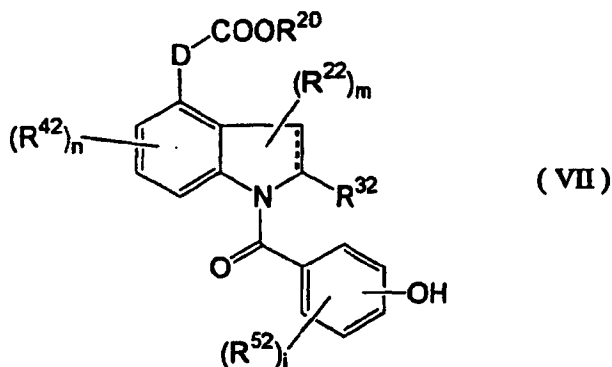
[0072] They only have to be a group that can be left easily and selectively except the above as protecting groups of hydroxyl or amino group, and are not especially limited. For example, the group described in T. W. Greene, Protective Groups in Organic Synthesis 3rd edition, Wiley, New York, (1999) may be used.

[0073] Though the persons skilled in the art can understand easily, the aimed compound of the present invention can be easily prepared by using these deprotection reactions properly.

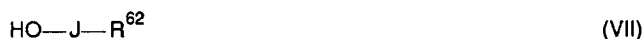
[0074] Among the compounds represented by formula (IV), a compound wherein G represents $-O-CH_2-$, that is, the compound represented by formula (IV-1)



wherein G^2 represents $-O-CH_2-$, and other symbols represent the same meaning as the described above may be prepared by subjecting a compound represented by formula (VII)



wherein R^{22} , R^{32} , R^{42} , and R^{62} represent the same meaning as R^2 , R^3 , R^4 , and R^5 , respectively, if they represent amino or hydroxyl group, they are necessary to be protected by the protecting group, and other symbols represent the same meaning as the described above and a compound represented by formula (VIII)



wherein R^{62} represents the same meaning as R^6 , if amino or hydroxyl group is included in them, they are necessary to be protected by the protecting group and J represents $-CH_2-$ to the etherification, and then, the deprotection optionally.

[0075] The etherification, which is well-known, is carried out by subjecting to react with a corresponding alcoholic compound at $0-60^\circ C$, for example, in an organic solvent (dichloromethane, diethyl ether, tetrahydrofuran, acetonitrile, benzene, and toluene, etc.), under the existence of azo-compounds (diethyl azodicarboxylate, diisopropyl azodicarboxylate, 1, 1'-(azodicarbonyl)dipiperidine, 1, 1'-azobis(N,N-dimethylformamide), etc.) and phosphine compounds

(triphenylphosphine, tributylphosphine, and trimethylphosphine, etc.).

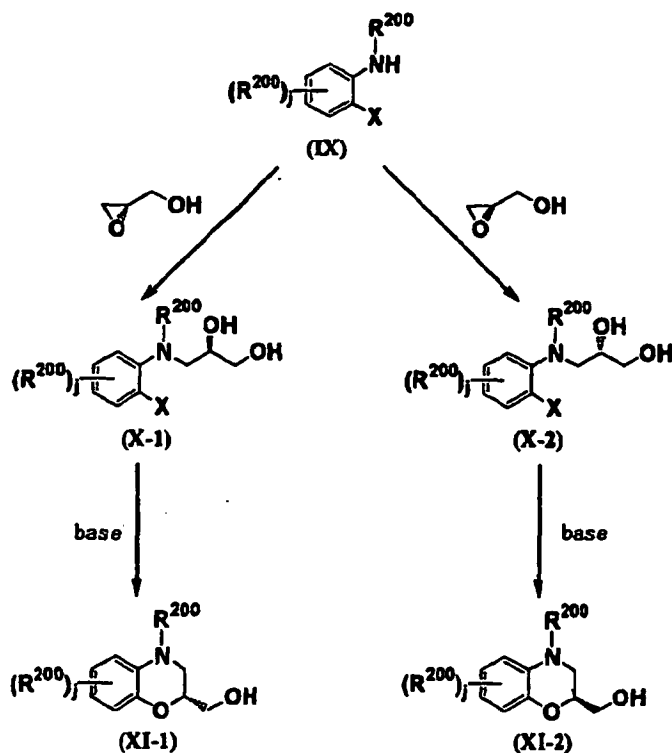
[0076] The deprotection reaction of the protecting group may be carried out by the method similar to the above.

[0077] The compounds represented by formula (II), (III), (V), (VI), (VII), (VIII), and (IX) are well-known or may be easily prepared by a well-known method.

[0078] For example, in the compound represented by formula (VIII), a compound wherein R₆₂ represents -3,4-dihydro-2H-1,4-benzoxazine may be prepared by the method shown by the following reaction process 1.

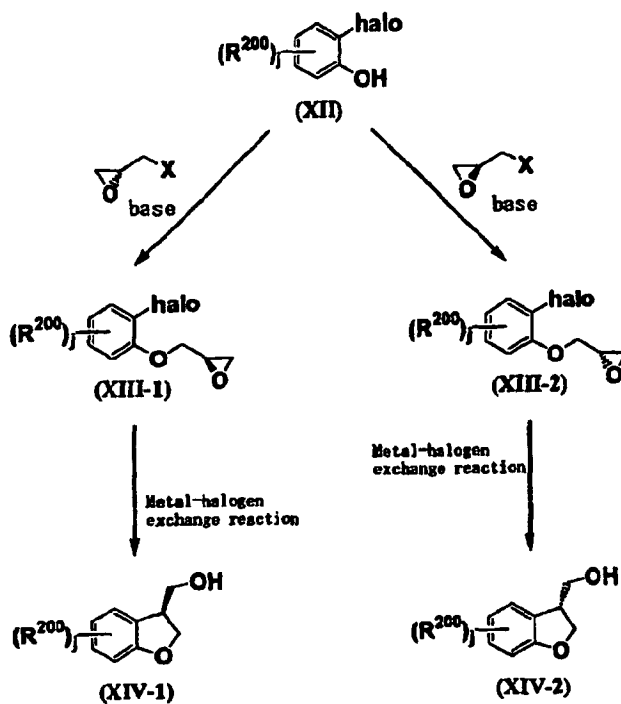
[0079] In the reaction process 1, R²⁰⁰ represents the group selected from C1-6 alkyl, C1-10 alkoxy, C2-6 alkoxyalkyl group, a halogen atom, hydroxyl, trihalomethyl, nitro, amino, phenyl, phenoxy, C2-6 acyl, C1-6 alkanesulfonyl, and cyano group and j represents the integer from 0 or 1 to 4, X represents a leaving group (for example, a halogen atom, methanesulfonyloxy, p-toluenesulfonyloxy, 3-nitrobenzenesulfonyloxy group, etc.), and other symbols represents the same meaning as the described above.

Reaction process 1



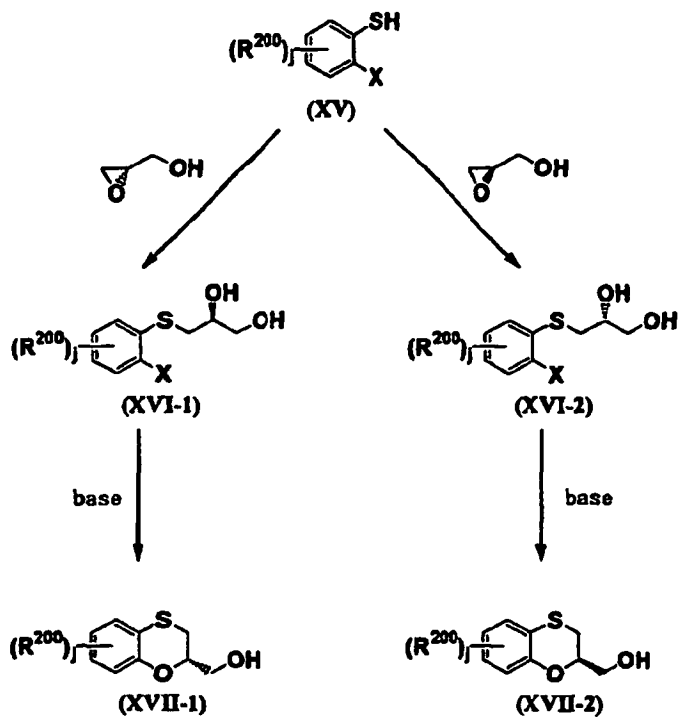
[0080] For example, among compounds represented by formula (VIII) a compound wherein R₆₂ represents -2,3-dihydrobenzofuran may be manufactured according to the method represented by the following reaction process 2.

[0081] In the reaction process 2, halo represents a halogen atom and other symbols represent the same meaning as the described above.

Reaction process 2

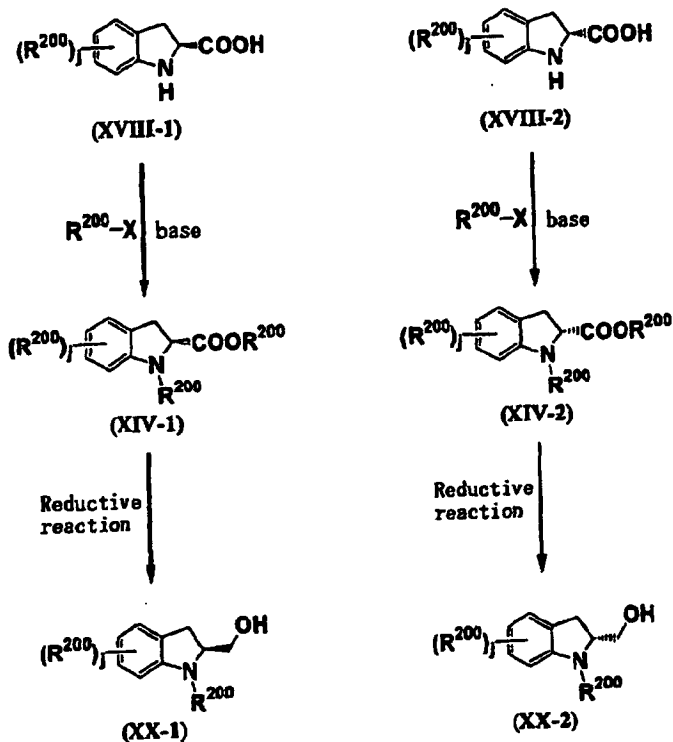
[0082] For example, among compounds shown by formula (VIII), the compound wherein R^{62} represents -1,4-benzoxathiane may be manufactured according to the method represented by the following reaction process 3.

[0083] All symbols represent the same meaning as the described above in the reaction process 3.

Reaction process 3

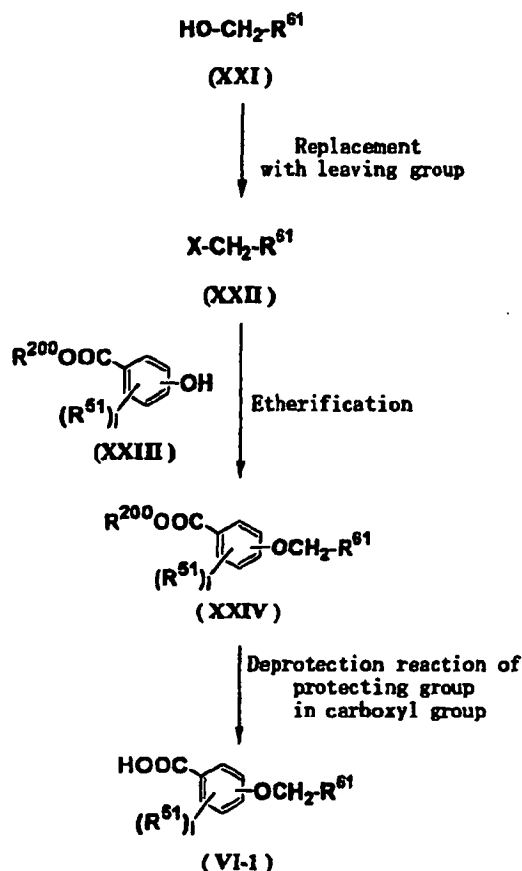
[0084] For example, among compounds shown by formula (VIII), the compound wherein R^{62} represents indoline may be manufactured according to the method represented by the following reaction process 4.

[0085] All symbols represent the same meaning as the described above in the reaction process 4.

Reaction process 4

[0086] For example, among compounds shown by formula (VI), the compound (VI-1) wherein G^1 represents $-OCH_2-$ may be manufactured according to the method represented by the following reaction process 5.

[0087] All symbols represent the same meaning as the described above in the reaction process 5.

Reductive reaction 5

[0088] In the reaction process 1 to 5, the compounds represented by formula (IX), (XII), (XV), (XVIII-1), (XVIII-2), (XXI), and (XXIII), which are used as starting materials, are well-known or may be easily prepared by a well-known method.

[0089] The reaction product may be purified by usual purification methods, for example, distillation and silicagel under normal or reduced pressure, high performance liquid chromatography, thin layer chromatography or column chromatography that used magnesium trisilicate, or wash and recrystallization, etc. The purification may be carried out at each reaction or after some reactions.

[0090] In the present invention, other starting materials and each reagent are well-known or may be easily prepared by a well-known method.

Pharmacological Activities:

[0091] The compound of the present invention represented by formula (I) potently binds to a DP receptor and shows an antagonistic activity. This effect was confirmed by the following receptor binding test using prostanoid receptor-expressing cells.

(i) Receptor binding test using prostanoid DP receptor-expressing, cells

[0092] CHO cells expressing mouse DP receptors were prepared according to the method of Hirata *et al.* (*Proc. Natl Acad Sci.*, **91**, 11192-11196 (1994)) and used as a membrane standard.

[0093] A reaction solution (200 μL) containing the prepared membrane standard (30-166 μg) and ^3H -PGD₂ was incubated at room temperature for 20 minutes. The reaction was stopped with an ice-cold buffer (1 mL) and the

binding $^3\text{H-PGD}_2$ was trapped in on a glass filter by immediate aspiration-filtration under a reduced pressure, and its binding radioactivity was measured using a liquid scintillation counter.

[0094] K_d value and B_{max} value were obtained from Scatchard plots (*Ann. N. Y. Acad. Sci.*, 51, 660 (1949)). Non-specific binding was obtained as the binding radioactivity in the presence of unlabeled PGD_2 at an excess amount (10 $\mu\text{mol/L}$). $^3\text{H-PGD}_2$ binding inhibition by the compound of the present invention was measured by adding $^3\text{H-PGD}_2$ (2.5 nmol/L) and the compound of the present invention as various concentrations. Also, the following buffers were used for the reactions.

Incubation buffer:

HEPES-NaOH (25 mmol/L , pH 7.4)
EDTA (1 mmol/L)
 MgCl_2 (5 mmol/L)
 MnCl_2 (10 mmol/L)

Buffer for washing:

Tris-HCl (10 mmol/L , pH 7.5)
NaCl (0.1 mol/L)
Bovine serum albumin (0.01%)

[0095] The dissociation constant (K_i) ($\mu\text{mol/L}$) of each compound was obtained by the following equation.

$$K_i = \text{IC}_{50} / (1 + ([L]^* / K_d))$$

[L*]: Concentration of radioligand

[0096] The result is shown in table 55.

Table 65

Example Num	DP K_i (μM)
2 (16)	0.031

[0097] As shown in the above results, it is apparent that the compound of the present invention potently binds to DP receptor.

(ii) DP antagonistic activity assay using prostanoid DP receptor-expressing cells may be examined by the following method.

[0098] CHO cells expressing mouse DP receptor were prepared, inoculated onto a 24-well microplate at 10^5 cells/well, followed by culturing for 2 days, and used for the assay. Each well was washed with 500 μL of MEM (minimum essential medium), and 450 μL of assay medium (MEM containing 1 mmol/L IBMX, 2 $\mu\text{mol/L}$ diclofenac and 0.1 or 1% BSA), followed by incubation at 37°C for 10 minutes. Then, an assay medium (50 μL) containing PGD_2 alone or PGD_2 with a compound of the present invention was added thereto to start the reaction, and after the reaction at 37°C for 10 minutes, 500 μL of ice-cold trichloroacetic acid (TCA) (10% w/v) was added thereto to stop the reaction. The reaction solution was frozen once (-80 °C) and thawed, and cells were peeled using a scraper, followed by centrifugation at 13,000 rpm for 3 minutes. The cAMP concentration was measured with a cAMP assay kit using the resulting supernatant. That is, [^{125}I]-cAMP assay kit buffer was added to 125 μL of the supernatant to give a total amount of 500 μL , and the resulting mixture was mixed with 1 mL of a chloroform solution of 0.5 mol/L tri-n-octylamine. Trichloroacetic acid (TCA) was extracted to the chloroform layer and removed, the cAMP amount in a sample was determined using the aqueous layer as the sample according to the method described in the [^{125}I]cAMP assay kit.

[0099] Also, with regard to the antagonistic activity (IC_{50}) of the test compound, the IC_{50} value was calculated as an inhibition rate based on the reaction at 100 nM which was a concentration showing submaximal cAMP production by PGD_2 alone.

Toxicity:

[0100] The toxicity of the compound represented by formula (I) of the present invention is very low so that it is

confirmed that the compound is sufficiently safe for using as a pharmaceutical.

Industrial applicability

5 Application to Pharmaceuticals:

[0101] Since the compound represented by formula (I) in the present invention binds and is antagonistic to PGD₂ receptor, especially DP receptor, it is considered to be useful for the prevention and/or treatment of diseases, for example, allergic diseases (allergic rhinitis, allergic conjunctivitis, atopic dermatitis, bronchial asthma, food allergy, etc.), systemic mastocytosis, disorders due to systemic mastocyte activation, anaphylactic shock, bronchoconstriction, urticaria, eczema, psoriasis, allergic bronchopulmonary aspergillosis, paranasal sinusitis, migraine, nasal polyp, hypersensitive angitis, eosinophilia, contact dermatitis, diseases accompanied with itching (such as atopic dermatitis, urticaria, allergic conjunctivitis, allergic rhinitis, contact dermatitis, etc.), secondary diseases (such as cataracta, retinodialysis, inflammation, infection, dysgryphia, etc.) generated by behaviors caused by itching (scratching behaviors, beating, etc.), inflammation, chronic obstructive pulmonary disease, ischemic reperfusion disorder, cerebrovascular disorder, brain damage, hepatopathy, graft rejection, autoimmune disease, rheumatoid arthritis, pleuritis complicated by rheumatoid arthritis, osteoarthritis, crohn's disease, ulcerative colitis, pain and the like. Moreover, it is considered to relate to sleeping and platelet aggregation and to be useful for these diseases.

[0102] Since a compound that weakly binds with receptors other than DP receptor doesn't appear other actions, it is a possibility to become a medicine having a little side reaction.

[0103] Since the compound represented by formula (I) in the present invention binds to CRTH2 receptor and it expected to be antagonistic to the biological activity, it is considered to be useful for the prevention and/or treatment of diseases, allergic diseases (allergic rhinitis, allergic conjunctivitis, atopic dermatitis, bronchial asthma, food allergy, etc.), systemic mastocytosis, disorders due to systemic mastocyte activation, anaphylactic shock, bronchoconstriction, urticaria, eczema, psoriasis, allergic bronchopulmonary aspergillosis, paranasal sinusitis, migraine, nasal polyp, hypersensitive angitis, eosinophilia, contact dermatitis, diseases accompanied with itching (such as atopic dermatitis, urticaria, allergic conjunctivitis, allergic rhinitis, contact dermatitis, etc.), secondary diseases (such as cataracta, retinodialysis, inflammation, infection, dysgryphia, etc.) generated by behaviors caused by itching (scratching behaviors, beating, etc.), inflammation, chronic obstructive pulmonary disease, ischemic reperfusion disorder, cerebrovascular disorder, brain damage, hepatopathy, graft rejection, autoimmune disease, rheumatoid arthritis, pleuritis complicated by rheumatoid arthritis, osteoarthritis, crohn's disease, ulcerative colitis, pain and the like.

[0104] The compound represented by formula (I) may be administered as other concomitant drug combining with other medicines, in order to

- 1) supplement and/or reinforce the prophylactic and /or therapeutic effect of the compounds,
- 2) improve the movement and absorption of the compounds, and to decrease the dosage, and/or
- 3) reduce the side effects of the compounds.

[0105] A combined drug with the compound represented by formula (I) and other medicine may be administered in the compounding agent that mixes both elements in a formulation or in the form administered as separate formulation. In the form administered as separate formulation, the different and simultaneous administration are included. In the different administration, the compound represented by formula (I) may be previously administered, followed by other medicines, or other medicines may be previously administered, followed by the compound represented by formula (I). Each medication method may be different or same.

[0106] Illnesses that the prophylactic and/or therapeutic effects of the above combined drugs can be expected, which only has to be one that the prophylactic and/or therapeutic effects of the compound represented by formula (I) is/are supplemented and/or reinforced, are not limited especially.

[0107] As other medicines to supplement and/or reinforce the prophylactic and/or therapeutic effects of the compounds represented by formula (I) on allergic rhinitis, for example, antihistamine agents, mediator release inhibitors, thromboxane synthesis enzyme inhibitors, thromboxane A₂ receptor antagonists, leukotriene receptor antagonists, steroid drugs, alpha-adrenergic receptor agonists, xanthine derivatives, cholinergic-blocking agents, and nitric oxide synthase inhibitors, etc. are included.

[0108] As other medicines to supplement and/or reinforce the prophylactic and/or therapeutic effects of the compounds represented by formula (I) on allergic conjunctivitis, for example, leukotriene receptor antagonists, antihistamine agents, mediator release inhibitors, nonsteroidal anti-inflammatory drugs, prostaglandins, steroid drugs, and nitric oxide synthase inhibitors, etc. are included.

[0109] As antihistamine agents, for example, ketotifen fumarate, mequitazine, azelastine hydrochloride, oxatomide, terfenadine, emedastine fumarate, epinastine hydrochloride, astemizole, ebastine, cetirizine hydrochloride, bepotast-

ine, fexofenadine, loratadine, desloratadine, olopatadine hydrochloride, TAK-427, ZCR-2060, NIP-530, mometasone furoate, mizolastine, BP-294, andolast, auranofine, and acribastin, etc. are included.

[0110] As mediator release inhibitors, for example, tranilast, sodium cromoglycate, amlexanox, repirinast, ibudilast, tazanolast, and pemirolast potassium, etc. are included.

[0111] As thromboxane synthesis enzyme inhibitors, for example, ozagrel hydrochloride and imitrodest sodium, etc. are included.

[0112] As thromboxane A2 receptor antagonists, for example, seratrodest, ramatroban, domitroban calcium hydrate, and KT-2-982, etc. are included.

[0113] As leukotriene receptor antagonist, for example, pranlukast hydrate, montelukast, zafirlukast, MCC-847, KCA-757, CS-615, YM-158, L-740515, CP-195494, LM-1484, RS-635, A-93178, S-36496, BIL-284, and ONO-4057, etc. are included.

[0114] In steroid drugs, for example, as drugs for external use, clobetasol propionate, diflorazone diacetate, fluocinonide, mometasone furancarboxylate, betamethasone dipropionate, betamethasone butyrate propionate, betamethasone valerate, difluprednate, budesonide, diflucortolone valerate, amcinonide, halcinonide, dexamethasone, dexamethasone propionate, dexamethasone valerate, dexamethasone acetate, hydrocortisone acetate, hydrocortisone butyrate, hydrocortisone butyrate propionate, deprodone propionate, prednisolone valerate-acetate, fluocinolone acetonide, beclomethasone dipropionate, triamcinolone acetonide, flumetasone pivalate, alclometasone propionate, clobetasone butyrate, prednisolone, beclomethasone propionate, and fludroxycortide, etc. are included.

[0115] As internal medicines and injections, cortisone acetate, hydrocortisone, hydrocortisone sodium phosphate, hydrocortisone sodium succinate, fludrocortisone acetate, prednisolone, prednisolone acetate, prednisolone sodium succinate, prednisolone butylacetate, prednisolone sodium phosphate, halopredone acetate, methylprednisolone, methylprednisolone acetate, sodium methylprednisolone succinate, triamcinolone, triamcinolone diacetate, triamcinolone acetonide, dexamethasone, dexamethasone acetate, dexamethasone sodium phosphate, dexamethasone palmitate, paramethasone acetate, and betamethasone, etc. are included.

[0116] As inhalants, beclomethasone dipropionate, fluticasone propionate, budesonide, flunisolide, triamcinolone, ST-126P, ciclesonide, dexamethasone palmitate, mometasone furancarboxylate, prasterone sulfonate, deflazacort, methylprednisolone suleptanate, and methylprednisolone sodium succinate, etc. are included.

[0117] As xanthine derivatives, for example, aminophylline, theophylline, doxophylline, cipamphylline, and diprophyl-line, etc. are included.

[0118] As cholinergic drugs, for example, ipratropium bromide, oxitropium bromide, flutropium bromide, cimetropium bromide, temiverine, tiotropium bromide, and revatropan(UK-112166), etc. are included.

[0119] As non-steroidal anti-inflammatory drugs, for example, sasapyrine, sodiumsalicylate, aspirin, aspirin dialuminate combination, diflunisal, indomethacin, suprofen, ufenamate, dimethylisopropylazulene, bufenamac, felbinac, diclofenac, tolmetin sodium, clinoril, fenbuten, nabumetone, piroglumetacine, indomethacin farnesyl, acetaminophen, flurbiprofen, flurbiprofen axetil, ketoprofen, fenoprofen calcium, tiaprofen, oxaprozin, naproxen, loxoprofen sodium, aluminoprophen, zaltoprofen, mefenamic acid, mefenamic acid aluminum, tolfenamic acid, floctafenine, ketophenylbutazone, oxyphenbutazone, piroxicam, tenoxicam, ampiroxicam, napagel in ointment, epirizole, tiaramide hydrochloride, tinoridine hydrochloride, emorfazone sulpyrine, migrenin, saridon, sedes G, amipilo-N, sorbon, pyrine drug for common cold, acetaminophen, phenacetin, dimetotiazine mesilate, simetride combination drug, and non-pyrine drug for common cold, etc. are included.

[0120] As prostaglandins (hereafter, abbreviated with PG), PG receptor agonists and PG receptor antagonist, etc. are included.

[0121] As PG receptor, PGE receptor (EP1, EP2, EP3, EP4), PGD receptor (DP, CRTH2), PGF receptor (FP), PGI receptor (IP), and TX receptor (TP), etc. are included.

[0122] Mass ratio of the compound represented by formula (I) to other medicine is not especially limited.

[0123] Other medicines may be administered combining with two arbitrary kinds or more.

[0124] In other medicines that supplement and/or reinforce prophylactic and/or therapeutic effects of the compounds represented by formula (I), not only one that has been found by present according on the above mechanism but also one that will be found in the future are included.

[0125] To use the compound represented by formula (I) or non-toxic -salt thereof, or a combined drug containing the compound represented by formula (I) and other medicines by the above purpose, it is usually administered systemically or locally, and orally or parenterally.

[0126] The dosage is determined depending on age, body weight, symptom, therapeutic effect, administration route, duration of the treatment and the like. Generally, 1mg to 1000mg per adult is orally administered once to several times per day, or 1mg to 100mg per adult is parenterally administered (preferably, nose drop, ophthalmic solution, ointment) once to several times per day, or intravenously administered for 1 to 24 hours per day, continuously.

[0127] Since the dose changes depending on various conditions as described above, there are cases in which doses

lower than or greater than the above ranges may be used.

[0128] When the compound represented by the formula (I) or the combined drug containing it and other medicines are administered, they are used as solid medicines, liquid medicines, and other compositions for internal use, and injections, external preparations, and suppositories, etc. for parenteral administration.

[0129] The solid compositions for oral administration include compressed tablets, pills, capsules, dispersing powders, granules, etc.

[0130] The capsules include hard capsules and soft capsules.

[0131] In such solid compositions, one or more active compound(s) is/are mixed with at least one inert diluent such as lactose, mannitol, glucose, hydroxypropyl cellulose, microcrystalline cellulose, starch, polyvinyl pyrrolidone or magnesium metasilicate aluminate. The compositions may also contain additional substances other than inert diluents, for example, lubricating agents such as magnesium stearate, disintegrating agents such as cellulose calcium glycolate, stabilizers such as lactose and solubilizers such as glutamic acid or aspartic acid according to usual methods. The tablets or pills may, if desired, be coated with film of gastric or enteric coating agents such as sugar, gelatin, hydroxypropyl cellulose or hydroxypropyl cellulose phthalate, or be coated with two or more films. Furthermore, capsules of absorbable materials such as gelatin are included.

[0132] The liquid compositions for oral administration include pharmaceutically acceptable emulsions, solutions, syrups and elixirs. In such liquid compositions, one or more active compound(s) is/are contained in inert diluents commonly used (purified water and ethanol, etc.). Furthermore, these compositions may also contain wetting agents, adjuvants such as suspending agents, sweetening agents, flavoring agents, perfuming agents, and preserving agents besides inert diluents.

[0133] Other compositions for oral administration include sprays that are prepared by known methods, and one or more active compound(s). These compositions may contain stabilizing agents such as sodium hydrogen sulfate, buffers to give isotonicity, and isotonic solutions such as sodium chloride, sodium citrate or citric acid besides inert diluents. Processes for preparing the sprays have been described in U.S. Patents 2,868,691 and 3,095,355.

[0134] The injections for parenteral administration include sterile aqueous and/or non-aqueous solutions, suspensions and emulsions. The aqueous solutions or suspensions include, for example, distilled water for injection and a physiological salt solution. The non-aqueous solutions or suspensions include propylene glycol, polyethylene glycol, plant oil such as olive oil, alcohol such as ethanol, POLYSORBATE 80 (registered trade mark), and the like. They may be used mixing sterile aqueous or non-aqueous solutions, suspensions and emulsions. These compositions may contain preserving agents, wetting agents, emulsifying agents, dispersing agents, stabilizing agents (for example, lactose), and adjuvants such as solubilizer (glutamic acid and aspartic acid, etc.). These may be sterilized by filtrating through a bacteria-retaining filter, mixing with antimicrobial agents, or irradiation. These may also be manufactured, for example, by making to be aseptic or dissolving to aseptic distilled water for injection or other solvents before use of sterile solid compositions.

[0135] As dosage forms of the ophthalmic solution for parenteral administration, ophthalmic solutions, ophthalmic suspensions, ophthalmic emulsions, ophthalmic solutions dissolved time of use, and ophthalmic ointment are included.

[0136] These ophthalmic solutions are manufactured based on a well-known method. For example, the ophthalmic solutions are made with tonicity agents (sodium chloride and concentrated glycerin, etc.), buffers (sodium phosphate and sodium acetate, etc.), surfactants (polysorbate 80 (trade name), polyoxyl 40 stearate, and polyoxyethylene hydrogenated castor oil, etc.), stabilizers (sodium citrate and disodium edetate, etc.), and preservatives (benzalkonium chloride and paraben, etc.), etc., which are properly selected optionally. These are sterilized in the final process or manufactured by the aseptic manipulation.

[0137] Inhalants for parenteral administration may include aerosol agents, inhalant powders or inhalant liquids, which may be used by being dissolved or suspended in water or other suitable media before using.

[0138] The inhalants are manufactured according to a well-known method.

[0139] For example, inhalant liquids are prepared properly selecting, if necessary, preservatives (benzalkonium chloride and paraben, etc.), coloring agents, buffers (sodium phosphate and sodium acetate, etc.), tonicity agents (sodium chloride and concentrated glycerin, etc.), thickeners (carboxyvinyl polymer, etc.), and absorption enhancers, etc.

[0140] Inhalant powders are prepared properly selecting, if necessary, lubricants (stearic acid and the salt, etc.), binders (starch and dextrin, etc.), fillers (lactose and cellulose, etc.), coloring agents, preservatives (benzalkonium chloride and paraben, etc.), and absorption enhancers, etc.

[0141] When the inhalant liquid is administered, sprayers (atomizer and nebulizer) are usually used, and when the inhalant powder is administered, an inhalation administering machine for powder is usually used.

[0142] As other compositions for parenteral administration, liquids for external use, ointments, liniments, suppositories for intrarectal administration, and pessaries for administering in vagina, which contain one or more activators and are prescribed with common procedure, are included.

Best Mode for Carrying Out the Invention

[0143] The following reference examples and examples illustrate the present invention, but do not limit the present invention.

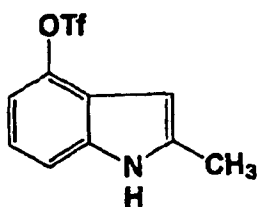
[0144] In the following chemical formula, Tf represents trifluoromethanesulfonyl group, Boc represents tert-butoxycarbonyl group, and TMS represents trimethylsilyl group.

[0145] The solvents in the parentheses in chromatographic separations or TLC show the developing or eluting solvents and the ratio shows volume ratio.

[0146] The solvents in the parentheses in NMR show the solvents for measurement.

Reference example 1

2-methyl-4-trifluoromethanesulfoxy-1H-indole

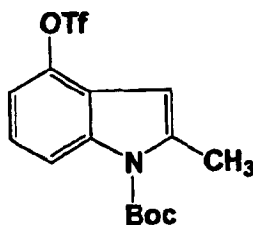


[0148] Dichloromethane (100ml) solution containing 2-methyl-4-hydroxy-2H-indole (10g) was stirred at 0°C, and lutidine (10.28ml) and anhydrous trifluoromethane sulfonic acid (13.72ml) were added to the solution, which was stirred at the same temperature for 1 hour. Further, water was added to the mixture, which was extracted by ethyl acetate. The water layer was extracted by ethyl acetate and the mixed organic layer was sequentially washed with water and saturated brine and dried by anhydrous sodium sulfate, and then concentrated by vacuum concentration to give a title compound having the following physical properties. The obtained title compound was used for the following reaction without further purification.

TLC: Rf 0.57 (hexane: ethyl acetate=7:3)

Reference example 2

1-tert-butoxycarbonyl-2-methyl-4-trifluoromethanesulfoxy-1H-indole

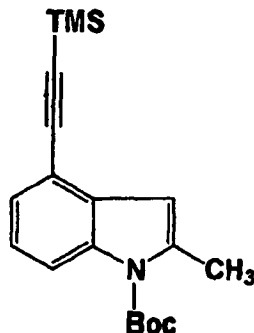


[0150] N, N-dimethylaminopyridine (catalyst quantity) were added to acetonitrile (12ml) solution containing the compound (1g) prepared according to reference example 1 and di-tert-butyl dicarbonate (1ml), which was stirred at room temperature over night. Further, water and ethyl acetate were added to the reaction solution, which was separated. The organic layer was sequentially washed with water and saturated brine and dried by anhydrous sodium sulfate, and concentrated by vacuum concentration to give a title compound (1.38g) having the following physical properties. TLC: Rf 0.50 (hexane: ethyl acetate=1:1)

Reference example 3

1-tert-butoxycarbonyl-2-methyl-4-(2-trimethylsilylethynyl)-1H-indole

[0151]

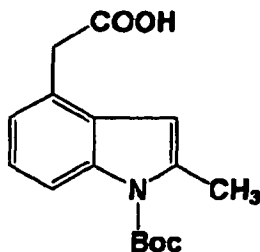


[0152] Trimethylsilylacetylene (11ml) was added to N, N-dimethylformamide (180ml) solution containing the compound (17.9g) prepared according to reference example 2, dichloridebis (triphenylphosphine) palladium (II) (1.6g), copper iodide (0.88g), and tetrabutylammonium (3.4g), and the mixture was stirred at 65°C for 2 hours. Further, 0.5N hydrochloric acid-ethyl acetate was added to the reactive mixture, and the insoluble matter was filtered through celite (registered trademark) and removed. The organic layer was sequentially washed with water (twice) and saturated brine and dried, and then concentrated by vacuum concentration. The residue was purified by silica gel column chromatography (hexane: ethyl acetate=10:1) to give a title compound (15.0g) having the following physical properties. NMR (CDCl₃): δ 8.09-8.05 (d, J = 8.5 Hz, 1H), 7.32-7.89 (m, 1H), 7.17-7.08 (m, 1H), 6.49 (s, 1H), 2.61 (s, 3H), 0.29 (s, 9H).

Reference example 4

1-tert-butoxycarbonyl-2-methyl-1H-indol-4-yl acetic acid

[0153]

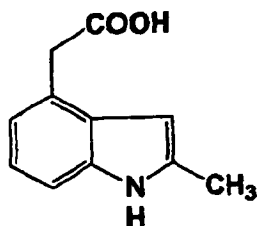


[0154] Tetrahydrofuran (160ml) solution containing cyclohexane (16.1ml) was cooled to -10°C and borane tetrahydrofuran complex (1M, 80ml) was dropped to the mixture, which was stirred at 0°C for 1 hour. Tetrahydrofuran (60ml) solution containing the compound (13.1g) prepared according to reference example 3 was dropped to this solution, which was stirred at room temperature for 1 hour. Further, 3N sodium hydroxide solution (40ml) and 30% hydrogen peroxide (45ml) were sequentially dropped to the reaction solution, which was stirred for 12 hours. The reactive mixture was extracted by water-diethyl ether, and the water layer was acidified with hydrochloric acid and extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine and dried, and concentrated by vacuum concentration to give a title compound (10.4g; crude product).

Reference example 5

2-methyl-1H-indol-4-yl acetic acid

[0155]

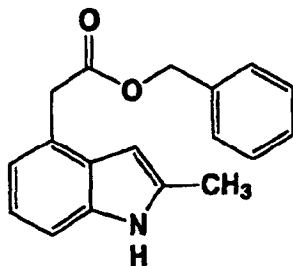


[0156] 5N sodium hydroxide solution (200ml) was dropped to methanol(200ml)-water (100ml) mixed solution containing the compound (96.3g) prepared according to reference example 4 at room temperature and the solution was stirred at 50°C for 3 hours and at room temperature for 12 hours. The reaction solution was extracted by hexane-ether and the water layers was acidified with hydrochloric acid and extracted by ethyl acetate. The extracted solution was sequentially washed with water and saturated brine and dried, and then concentrated by vacuum concentration to give a title compound (53.9g; crude product).

Reference example 6

2-methyl-1H-indol-4-yl acetic acid benzylester

[0157]



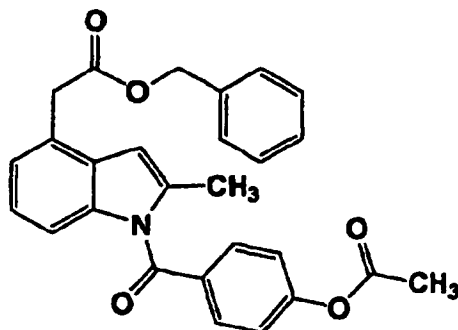
[0158] Under argon gas, potassium carbonate (109g) was added to N, N-dimethyl formamide (500ml) solution containing the compound (55.0g) prepared according to reference example 5 over violent stir. Benzyl bromide (34.6ml) was added to the mixture, which was stirred at room temperature for 2 hours. The solution was poured into water and extracted with toluene. The organic layer was sequentially washed with water and saturated brine and dried by sulfuric anhydride sodium, and filtered. The filtrate was concentrated by vacuum concentration. The residue was purified by silica gel column chromatography (hexane: ethyl acetate=5:1) to give a title compound (70.3g) having the following physical properties.

TLC: Rf 0.85 (hexane: ethyl acetate=1:1)

Reference example 7

1-(4-acetoxymethyl-2-methyl-1H-indol-4-yl)acetic acid benzyl ester

[0159]



[0160] Under argon gas, a mixture of 4-acetoxymethylbenzoic acid (516mg), oxalylchloride (0.5ml), and N, N-dimethylformamide (5μl) was stirred for 3 hours. The mixture was concentrated by vacuum concentration and 4-acetoxymethylbenzoic acid chloride was prepared. Sodium hydroxide (286mg) and tetrabutylammonium chloride (20mg) were added to dichloromethane (7ml) solution containing the compound (400mg) prepared according to reference example 6 at room temperature over stir. Dichloromethane (3ml) solution containing 4-acetoxymethylbenzoic acid chloride prepared by the described above was added to the mixture, which was stirred at room temperature for 1 hour. The reaction mixture was filtered and the filtrate was concentrated, and the residue was purified by silica gel column chromatography (hexane: ethyl acetate=7:3) to give a title compound (500mg) having the following physical properties.

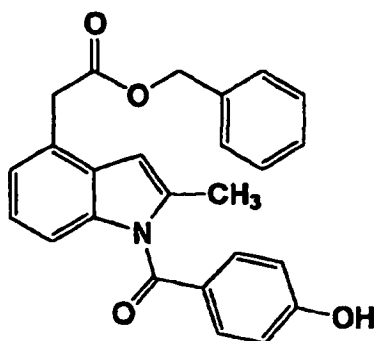
TLC: Rf 0.34 (hexane: ethyl acetate=7:3)

NMR (CDCl₃): δ 7.76 (d, J = 8.7 Hz, 2H), 7.40-7.20 (m, 7H), 7.08-6.92 (m, 3H), 6.47 (s, 1H), 5.15 (s, 2H), 3.88 (s, 2H), 2.40 (s, 3H), 2.35 (s, 3H).

Reference example 8

1-(4-hydroxymethyl-2-methyl-1H-indol-4-yl)acetic acid benzyl ester

[0161]



[0162] The compound (500mg) prepared according to reference example 7 was dissolved to dichloromethane (5ml) solution, and piperidine (0.22ml) was added, and then the solution was stirred for 1 hour. The reaction mixture was concentrated and the residue was purified by silica gel column chromatography (chloroform: methanol=19:1) to give a title compound (450mg) having the following physical properties.

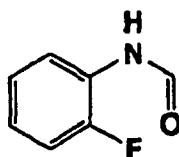
TLC: Rf 0.61 (chloroform: methanol=9:1)

NMR(CDCl₃): δ 7.72 (m, 2H), 7.44-7.26 (m, 5H), 7.08-6.84 (m, 5H), 6.45 (s, 1H), 5.83 (brs, 1H), 5.15 (s, 2H), 3.88 (s, 2H), 2.42 (s, 3H).

Reference example 9

2-fluoro-N-formyl aniline

[0163]



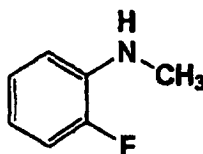
[0164] Under argon gas, at 0°C, formic acid (6.1ml) was dropped to acetic anhydride (15.5ml), which was stirred at 50°C for 2 hours. The reaction solution was left up to room temperature, and diluted with tetrahydrofuran (10ml). At room temperature, tetrahydrofuran (20ml) solution containing 2-fluoroaniline (5.56g) added to the above solution, which was stirred at room temperature for 1 hour. The reaction solution was concentrated to give a title compound having the following physical properties. The obtained title compound was used for the following reaction without further purification.

TLC: Rf 0.70 (hexane: ethyl acetate=2:1)

Reference example 10

2-fluoro-N-methylaniline

[0165]



[0166] Under argon gas, borane tetrahydrofuran complex (1M tetrahydrofuran solution, 125ml) was added to anhydrous tetrahydrofuran (25ml) solution containing the compound (7g) prepared according to reference example 9 at 0°C, which was stirred at 50°C for 2 hours. The reaction solution was left up to room temperature and cold methanol (30ml) was added. 4N hydrogen chloride dioxane solution (10ml) was added to the reaction solution, which was stirred at 60°C for 1 hour. The reaction solution was concentrated and poured into 2N sodium hydroxide solution, and extracted by ethyl acetate. The organic layer was washed with saturated brine and dried by sulfuric anhydride sodium. The solution was filtered through celite (registered trademark), and concentrated. The mixture of hexane and ethyl acetate (10:1) was added to the residue and filtered by silicagel. The solution was concentrated to give a title compound (6.45g) having the following physical properties.

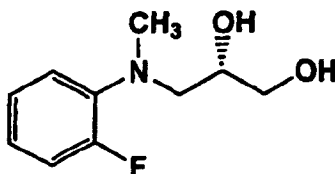
TLC: Rf 0.85 (hexane: ethyl acetate=5: 1)

NMR(CDCl₃): δ 7.00-6.91 (m, 2H), 6.80-6.55 (m, 2H), 3.90 (br.s, 1H), 2.82 (s, 3H).

Reference example 11

(2S)-3-(N-(2-fluorophenyl)-N-methylamino)-1, 2-propanediol

[0167]

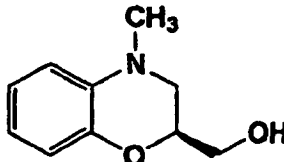


[0168] Under argon gas, the mixture of the compound (1.24g) prepared according to reference example 10, (R)-(+)-glycidol (1.11g, made by Aldrich Corporation, 98%ee), and ethanol(1ml) was stirred at 50°C for 12 hours. The reaction solution was concentrated to give a title compound having the following physical properties. The obtained title compound was used for the following reaction without further purification.
TLC: Rf 0.40 (hexane: ethyl acetate=1:1)

Reference example 12

(2S)-2-hydroxymethyl-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0169]



[0170] On ice, potassium tert-butoxide (1.68g) was added to anhydrous N, N-dimethyl formamide (10ml) solution containing the compound prepared according to reference example 11 over stir. The reaction solution was stirred at 80°C for 3 hours and poured into water, and extracted by ethyl acetate. The organic layer was washed with saturated brine and dried by the sulfuric anhydride sodium. The solution was filtered through celite (registered trademark) and concentrated. The residue was purified by silica gel column chromatography (hexane: ethyl acetate=3:1) to give a title compound(1.55g 97.6%ee) having the following physical properties.

TLC: Rf 0.35 (hexane: ethyl acetate=2:1)

NMR(CDCl₃): δ 7.90-6.79 (m, 2H), 6.70-6.60 (m, 2H), 4.33 (m, 1H), 3.82 (dd, J = 13.0, 4.2 Hz, 1H), 3.79 (dd, J = 13.0, 4.2 Hz, 1H), 3.19 (dd, J = 10.2, 2.1 Hz, 1H), 3.17 (dd, J = 11.4, 5.4 Hz, 1H), 2.86 (s, 3H).

The optical purity of this title compound was decided by using high performance liquid chromatography (HPLC).

Column: CHIRALCEL OD (Daicel Chemical Industries Ltd.)

0.46cmφ×25cm

Flow rate: 1ml/minute

Solvent: hexane: 2-propanol = 93:7

Detected wave-length: 254nm

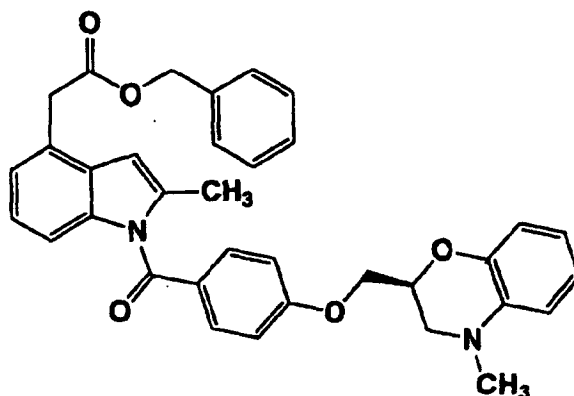
Retention time: 30.70 minutes

Temperature: 24°C.

Example 1

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid benzyl ester

[0171]



[0172] Under argon gas, the compound (33.0g) prepared according to reference example 12 and triphenylphosphine (44.8g) were added to tetrahydrofuran (300ml) solution containing the compound (65.0g) prepared according to reference example 8, and then diethyl azodicarbonate (40% toluene solution; 74.6ml) was added to the solution, which was stirred at room temperature for 1 hour. The reaction solution was concentrated and the residue was purified by silica gel column chromatography (ethyl acetate: hexane=1:4 to 1:3) to give a title compound (168g) having the following physical properties.

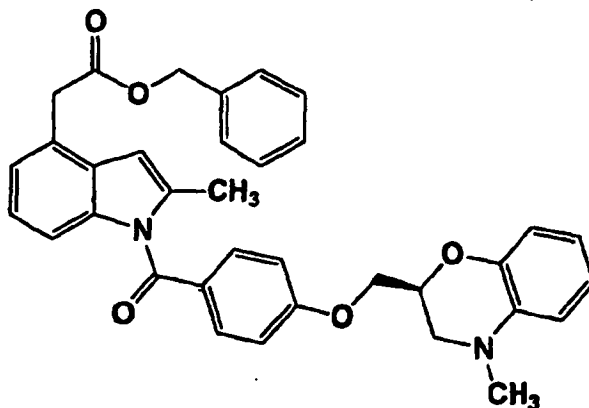
TLC: R_f 0.25 (ethyl acetate: hexane=1:3)

NMR(CDCl₃): δ 7.71 (d, J = 8.8 Hz, 2H), 7.43-7.18 (m, 4H), 7.08-6.80 (m, 8H), 6.80-6.65 (m, 2H), 6.46 (s, 1H), 5.15 (s, 2H), 4.68 (m, 1H), 4.31 (dd, J = 9.8, 5.0 Hz, 1H), 4.21 (dd, J = 9.8, 6.2 Hz, 1H), 3.88 (s, 2H), 3.41 (dd, J = 11.4, 3.0 Hz, 1H), 3.28 (dd, J = 11.4, 6.4 Hz, 1H), 2.92 (s, 3H), 2.42 (s, 3H).

Example 1(1)

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid benzyl ester

[0173]

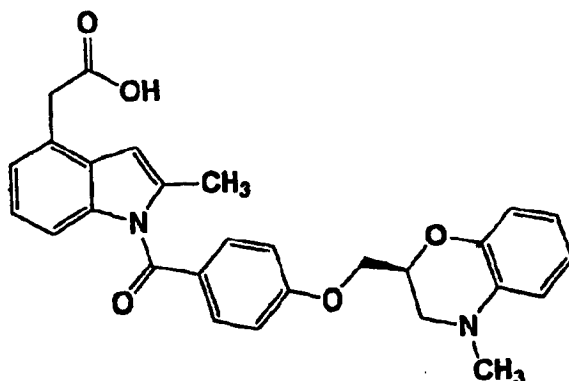


[0174] The compound (910mg) prepared according to reference example 18 was suspended to tetrahydrofuran(2ml), and oxalylchloride(0.29ml) was added to the mixture, which was stirred for 1.5 hours at 40°C. The reaction solution was cooled up to room temperature. The compound (559mg) prepared according to reference example 6 was dissolved to a mixture of acetonitrile (1ml) and ethyl acetate (1ml), and then triethylamine (1.7ml) and N, N-dimethylaminopyridine (73mg) were added to the mixture, which was cooled. The tetrahydrofuran solution containing the above acid chloride was dropped to the solution, which was stirred for 8 hours at 40°C and cooled up to room temperature. Saturated sodium bicarbonate solution (10ml) was added to the reaction solution, which was extracted by ethyl acetate, and then the water layer was extracted by ethyl acetate. Further, it was mixed with the organic layer and sequentially washed with water and saturated brine and dried by sulfuric anhydride sodium. The residue obtained by removal of the solvent was purified by silica gel column chromatography (hexane: ethyl acetate=4:1 to 2:1) to give the compound (991g) of the present compound having the same physical properties as example 1.

Example 2

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0175]



[0176] Under hydrogen gas, 20% hydroxide palladium carbon (50% hydrate, 17g) was added to ethyl acetate (830ml) solution containing the compound (168g) prepared according to example 1 or example 1(1), and stirred for 4 hours at room temperature. The reaction solution was filtered through celite (registered trademark) and the filtrate was concentrated. The mixture of ethanol water-ethyl acetate was added to the obtained residue, and solidified. The solid was obtained by filtration and dried after washing with diethyl ether to give the present compound (85.8g, 99.6% ee) having the following physical properties. Further, it was optionally converted into the corresponding salt by a well-known method to give the following compound of the present invention.

Free body;

TLC:Rf 0.26 (methanol:chloroform=1:10);

NMR(CDCl₃): δ 7.71 (d, J = 9.0 Hz, 2H), 7.20-6.78 (m, 7H), 6.78-6.64 (m, 2H), 6.49 (s, 1H), 4.68 (m, 1H), 4.30 (dd, J = 9.9, 5.4 Hz, 1H), 4.21 (dd, J = 9.9, 6.0 Hz, 1H), 3.86 (s, 2H), 3.40 (dd, J = 11.4, 2.7 Hz, 1H), 3.27 (dd, J = 11.4, 6.6 Hz, 1H), 2.92 (s, 3H), 2.44 (s, 3H).

The optical purity of this title compound was decided by using high performance liquid chromatography (HPLC).

Column: CHIRALCEL OD (Daicel Chemical Industries Ltd.)

0.46cm ϕ ×25cm

Flow rate: 0.5ml/minute

Solvent: acetonitrile: 1.0N sodium perchlorate solution= 85:15

Detected wave-length: 262nm

Retention time: 14.38 minutes

Temperature: 25°C.

Sodium trihydrate:

TLC:Rf 0.37 (chloroform:methanol=10:1);

NMR(CDCl₃+CD₃OD): δ 7.68 (d, J = 8.8 Hz, 2H), 7.35-6.77 (m, 7H), 6.77-6.60 (m, 2H), 6.54 (s, 1H), 4.72-4.60 (m, 1H), 4.29 (dd, J = 9.6, 5.0 Hz, 1H), 4.25-4.20 (dd, 9.6, 5.8 Hz, 1H), 3.71 (s, 2H), 3.40 (dd, J = 11.6, 2.8 Hz, 1H), 3.28 (dd, J = 11.6, 6.4 Hz, 1H), 2.91 (s, 3H), 2.39 (s, 3H).

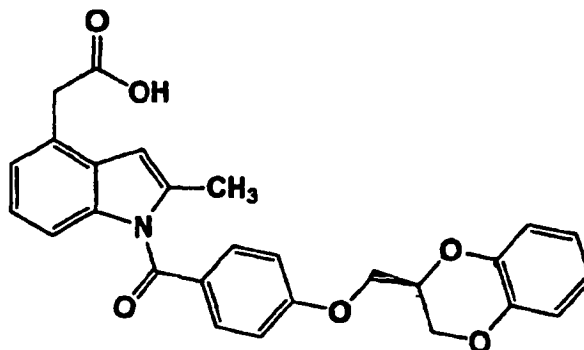
Example 2(1) to example 2(27)

[0177] Instead of the compound prepared according to reference example 8 and the compound prepared according to reference example 12, using the compounds prepared according to reference example 23(1)-(11) described later, reference example 25, reference example 26, reference example 28, reference examples 28(1), or the corresponding alcoholic derivatives, the following compounds in the present invention, which were converted into the corresponding salts, were obtained by an operation similar to the method represented from example 1 to example 2, and then a well-known method optionally.

Example 2(1)

1-(4-((2R)-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0178]



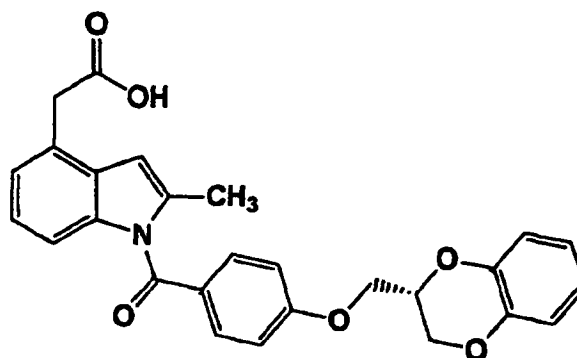
TLC:Rf 0.30 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.75-7.70 (m, 2H), 7.07-6.86 (m, 9H), 6.49 (m, 1H), 4.61 (m, 1H), 4.42 (dd, J = 11.4, 2.1 Hz, 1H), 4.33 (dd, J = 10.2, 5.1 Hz, 1H), 4.26 (dd, J = 11.4, 6.3 Hz, 1H), 4.25 (dd, J = 10.2, 6.0 Hz, 1H), 3.87 (s, 2H), 2.44 (d, J = 1.2 Hz, 3H).

Example 2(2)

1-(4-((2S)-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indole-4-yl acetic acid

[0179]



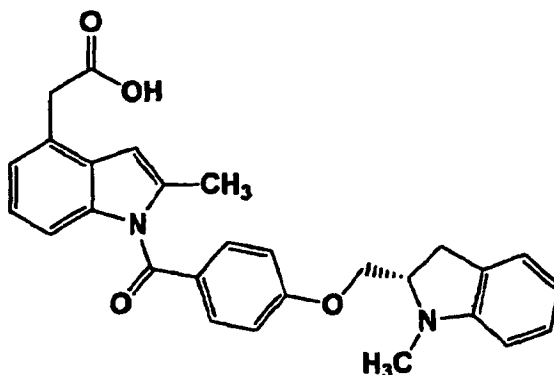
TLC:Rf 0.30 (chloroform: methanol=10:1);

NMR (CDCl₃) : δ 7.75-7.70 (m, 2H), 7.07-6.86 (m, 9H), 6.50 (m, 1H), 4.61 (m, 1H), 4.42 (dd, J = 11.4, 2.4 Hz, 1H), 4.33 (dd, J = 9.9, 5.1 Hz, 1H), 4.26 (dd, J = 11.4, 6.6 Hz, 1H), 4.25 (dd, J = 9.9, 6.0 Hz, 1H), 3.87 (s, 2H), 2.44 (d, J = 1.2 Hz, 3H).

Example 2(3)

1-(4-((2S)-1-methylindolin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0180]

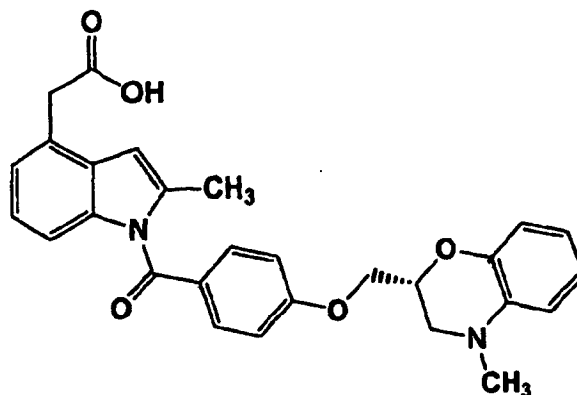


TLC:Rf 0.49 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.76-7.66 (m, 2H), 7.20-6.46 (m, 10H), 5.00-2.80 (m, 5H), 3.87 (s, 2H), 2.94 and 2.91 (each s, total 3H), 2.45 (s, 3H).Example 2(4)

1-(4-((2R)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0181]



TLC:Rf 0.26 (methanol: chloroform= 1:10);

NMR(CDCl₃): δ 7.72 (d, J = 8.8 Hz, 2H), 7.12-6.79 (m, 7H), 6.72 (d, J = 7.4 Hz, 2H), 6.49 (s, 1H), 4.68 (m, 1H), 4.31 (dd, J = 9.6, 5.2 Hz, 1H), 4.20 (dd, J = 9.6, 6.2 Hz, 1H), 3.87 (s, 2H), 3.40 (dd, J = 11.6, 2.8 Hz, 1H), 3.28 (dd, J = 11.6, 6.2 Hz, 1H), 2.92 (s, 3H), 2.45 (s, 3H).

The optical purity of this title compound was decided by using high performance liquid chromatography (HPLC).

Column: CHIRALCEL OD (Daicel Chemical Industries Ltd.)

0.46cm ϕ ×25cm

Flow rate: 0.5ml/minute

Solvent: acetonitrile: 1.0N sodium perchlorate solution= 85:15

Detected wave-length: 262nm

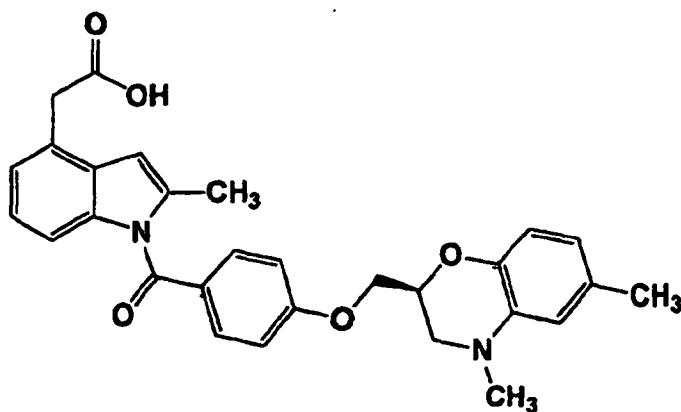
Retention time: 16.88 minutes

Temperature: 25°C.

Example 2(5)

1-(4-((2S)-4,6-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0182]



Free body:

TLC:Rf 0.37 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.74-7.69 (m, 2H), 7.06-6.82 (m, 5H), 6.73 (d, J = 8.1 Hz, 1H), 6.54-6.47 (m, 3H), 4.64 (m, 1H), 4.30 (dd, J = 9.9, 5.1 Hz, 1H), 4.20 (dd, J = 9.9, 6.3 Hz, 1H), 3.87 (s, 2H), 3.39 (dd, J = 11.4, 2.7 Hz, 1H), 3.26 (dd, J = 11.4, 6.6 Hz, 1H), 2.90 (s, 3H), 2.45 (d, J = 0.9 Hz, 3H), 2.28 (s, 3H).

Hydrochloride:

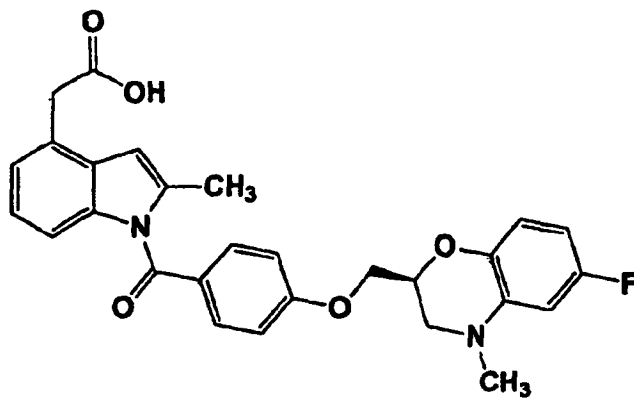
TLC:Rf 0.45 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.72 (d, J = 8.4 Hz, 1H), 7.10-6.87 (m, 8H), 6.50 (s, 1H), 4.85 (m, 1H), 4.35 (m, 2H), 3.86 (s, 2H), 3.75 (m, 1H), 3.55 (m, 1H), 3.18 (s, 3H), 2.44 (s, 3H), 2.32 (s, 3H).

Example 2(6)

1-(4-((2S)-6-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0183]



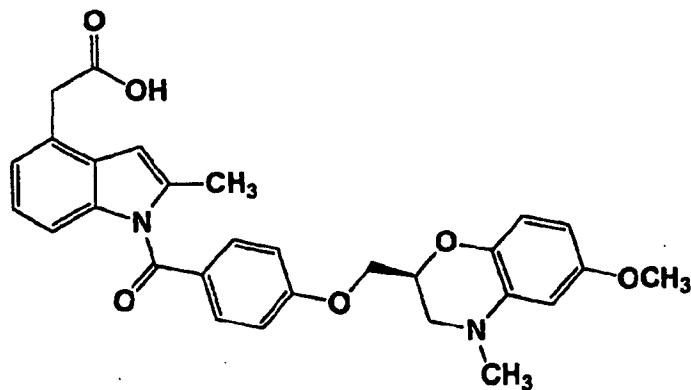
TLC:Rf 0.33 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.72 (d, J = 8.7 Hz, 2H), 7.07-6.90 (m, 5H), 6.74 (dd, J = 9.0, 5.7 Hz, 1H), 6.49 (s, 1H), 6.45-6.30 (m, 2H), 4.66-4.53 (m, 1H), 4.29 (dd, J = 9.6, 4.8 Hz, 1H), 4.18 (dd, J = 9.6, 6.3 Hz, 1H), 3.87 (s, 2H), 3.40 (dd, J = 12.0, 3.0 Hz, 1H), 3.30 (dd, J = 12.0, 6.9 Hz, 1H), 2.91 (s, 3H), 2.45 (s, 3H).

Example 2(7)

1-(4-((2S)-6-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0184]



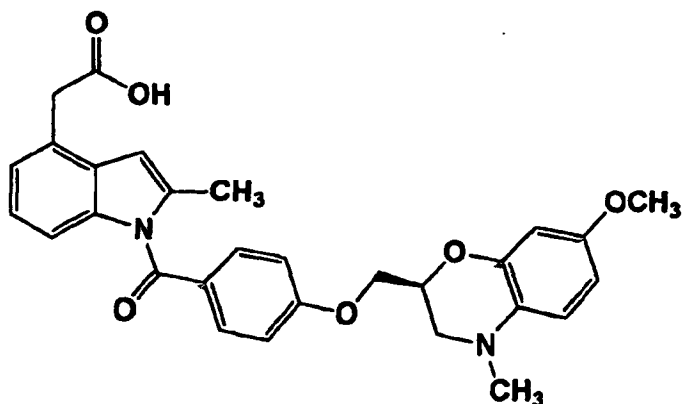
TLC:Rf 0.36 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.74-7.69 (m, 2H), 7.06-6.92 (m, 5H), 6.74 (d, J = 8.4 Hz, 1H), 6.49 (m, 1H), 6.29 (d, J = 3.0 Hz, 1H), 6.23 (dd, J = 8.4, 3.0 Hz, 1H), 4.68 (m, 1H), 4.29 (dd, J = 9.9, 4.8 Hz, 1H), 4.18 (dd, J = 9.9, 6.3 Hz, 1H), 3.85 (s, 2H), 3.76 (s, 3H), 3.39 (dd, J = 11.4, 2.7 Hz, 1H), 3.28 (dd, J = 11.4, 6.6 Hz, 1H), 2.90 (s, 3H), 2.44 (d, J = 0.9 Hz, 3H).

Example 2(8)

1-(4-((2S)-7-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0185]



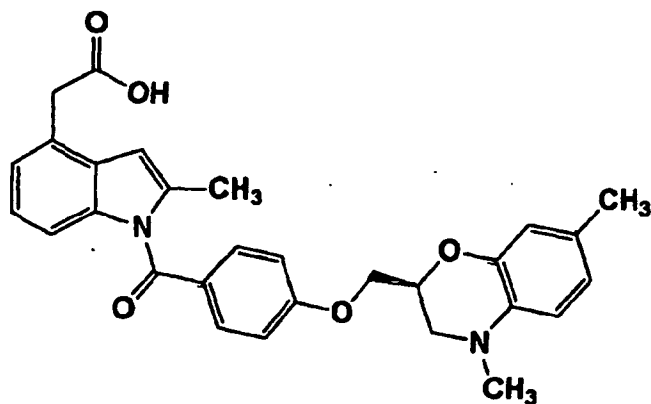
TLC:Rf 0.41 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.72 (d, J = 9.0 Hz, 2H), 7.08-6.90 (m, 5H), 6.69-6.62 (m, 1H), 6.52-6.43 (m, 3H), 4.75-4.64 (m, 1H), 4.31 (dd, J = 9.9, 5.1 Hz, 1H), 4.22 (dd, J = 9.9, 6.0 Hz, 1H), 3.87 (s, 2H), 3.74 (s, 3H), 3.33 (dd, J = 11.7, 2.7 Hz, 1H), 3.18 (dd, J = 11.7, 6.9 Hz, 1H), 2.86 (s, 3H), 2.45 (s, 3H).

Example 2(9)

1-(4-((2S)-4, 7-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0186]



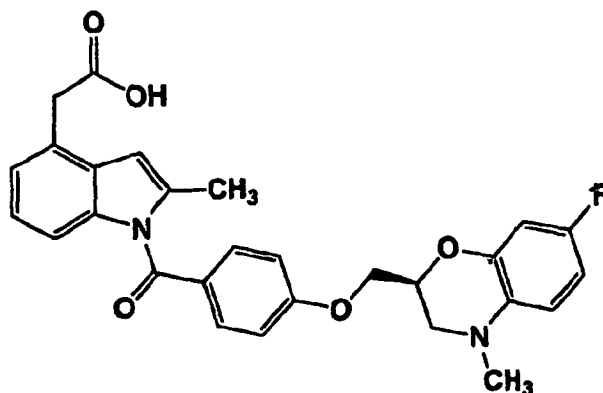
TLC:Rf 0.41 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.71 (d, J = 9.0 Hz, 2H), 7.08-6.85 (m, 5H), 6.73-6.59 (m, 3H), 6.50 (s, 1H), 4.73-4.62 (m, 1H), 4.30 (dd, J = 9.9, 5.1 Hz, 1H), 4.21 (dd, J = 9.9, 6.3 Hz, 1H), 3.87 (s, 2H), 3.36 (dd, J = 11.7, 3.0 Hz, 1H), 3.22 (dd, J = 11.7, 6.3 Hz, 1H), 2.88 (s, 3H), 2.45 (s, 3H), 2.23 (s, 3H).

Example 2(10)

1-(4-((2S)-7-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0187]

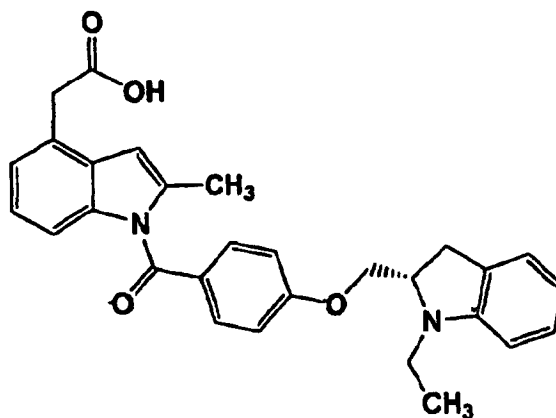


TLC:Rf 0.34 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.72 (d, J = 9.0 Hz, 2H), 7.09-6.92 (m, 5H), 6.60 (d, J = 8.1 Hz, 3H), 6.50 (s, 1H), 4.75-4.65 (m, 1H), 4.36-4.17 (m, 2H), 3.87 (s, 2H), 3.39-3.18 (m, 2H), 2.88 (s, 3H), 2.45 (s, 3H).Example 2(11)

1-(4-((2S)-1-ethylindolin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0188]



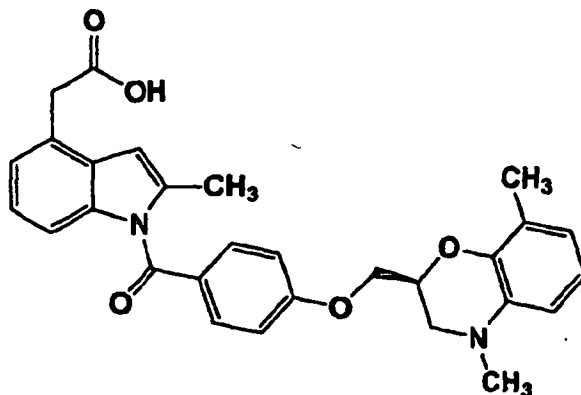
TLC:RF 0.45 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.72 (dd, J = 9.0, 1.2 Hz, 2H), 7.17-6.82 (m, 7H), 6.70-6.80 (m) and 6.53-6.43 (m) total 3H, 4.97-4.84 (m) and 4.33-4.03 (m) total 2H, 3.86 (s, 2H), 3.58-3.15 (m) and 3.07-2.83 (m) total 5H, 2.44 (s, 3H), 1.21-1.10 (m, 3H).

Example 2(12)

1-(4-((2S)-4, 8-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0189]

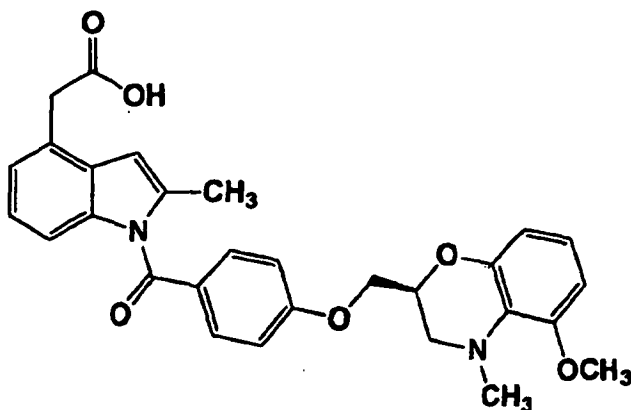
TLC:R_f 0.39 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.74-7.69 (m, 2H), 7.08-6.93 (m, 5H), 6.78 (dd, J = 8.1, 7.5 Hz, 1H), 6.58 (d, J = 8.1 Hz, 1H), 6.58 (d, J = 7.5 Hz, 1H), 6.49 (m, 1H), 4.68 (m, 1H), 4.32 (dd, J = 9.9, 4.8 Hz, 1H), 4.23 (dd, J = 9.9, 6.6 Hz, 1H), 3.86 (s, 2H), 3.40 (dd, J = 11.4, 2.7 Hz, 1H), 3.25 (dd, J = 11.4, 6.6 Hz, 1H), 2.90 (s, 3H), 2.44 (d, J = 1.2 Hz, 3H), 2.18 (s, 3H).

Example 2(13)

1-(4-((2S)-5-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0190]

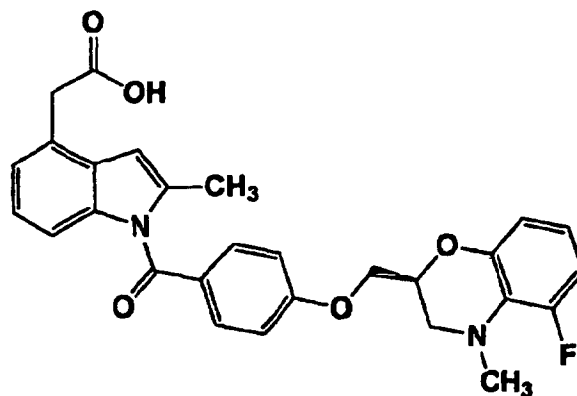
TLC:R_f 0.38 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.72 (d, J = 8.4 Hz, 2H), 7.10-6.86 (m, 6H), 6.60 (dd, J = 8.4, 1.5 Hz, 1H), 6.55-6.45 (m, 2H), 4.4, 6.4, 3.1 (m, 2H), 4.27-4.17 (m, 1H), 3.90 (s, 3H), 3.85 (s, 2H), 3.28 (dd, J = 13.5, 2.1 Hz, 1H), 3.13 (dd, J = 13.5, 9.3 Hz, 1H), 2.90 (s, 3H), 2.44 (s, 3H).

Example 2(14)

1-(4-((2S)-5-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0191]

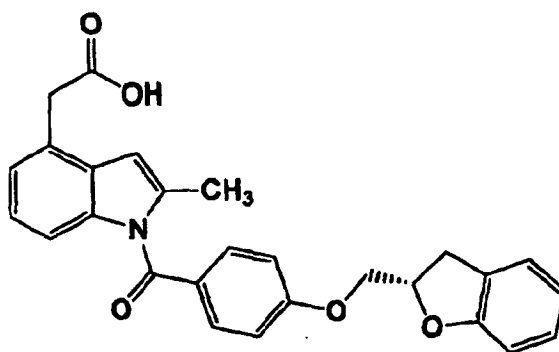


TLC:Rf 0.36 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.73 (d, J = 9.0 Hz, 2H), 7.09-6.92 (m, 5H), 6.81-6.62 (m, 3H), 6.49 (s, 1H), 4.49-4.40 (m, 1H), 4.38-4.18 (m, 2H), 3.87 (s, 2H), 3.38-3.15 (m, 2H), 3.00 (d, J = 1.8 Hz, 3H), 2.45 (s, 3H).Example 2(15)

1-(4-((2S)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0192]



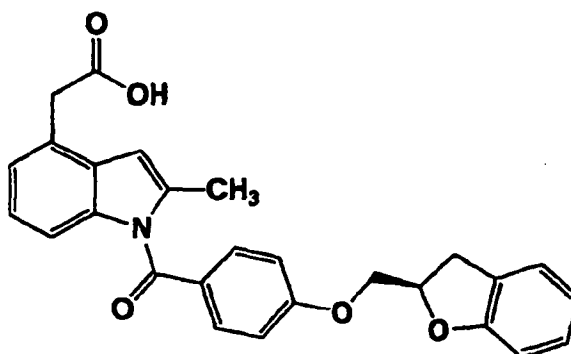
TLC:Rf 0.51 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.71 (d, J = 8.7 Hz, 2H), 7.21 (d, J = 7.2 Hz, 1H), 7.15 (t, J = 7.2 Hz, 1H), 7.08-6.81 (m, 7H), 6.49 (s, 1H), 5.25-5.14 (m, 1H), 4.29 (dd, J = 10.2, 6.3 Hz, 1H), 4.21 (dd, J = 10.2, 4.2 Hz, 1H), 3.87 (s, 2H), 3.43 (dd, J = 15.9, 9.6 Hz, 1H), 3.17 (dd, J = 15.9, 7.2 Hz, 1H), 2.45 (s, 3H).

Example 2(16)

1-(4-((2R)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-3H-indol-4-yl acetic acid

[0193]



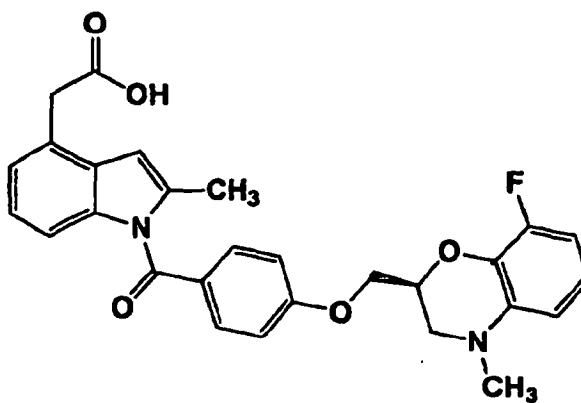
TLC:Rf 0.51 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.71 (d, J = 8.7 Hz, 2H), 7.21 (d, J = 7.2 Hz, 1H), 7.15 (t, J = 7.2 Hz, 1H), 7.08-6.81 (m, 7H), 6.49 (s, 1H), 5.25-5.14 (m, 1H), 4.29 (dd, J = 10.2, 6.3 Hz, 1H), 4.21 (dd, J = 10.2, 4.2 Hz, 1H), 3.87 (s, 2H), 3.43 (dd, J = 15.9, 9.6 Hz, 1H), 3.17 (dd, J = 15.9, 7.2 Hz, 1H), 2.45 (s, 3H).

Example 2(17)

1-(4-((2S)-8-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0194]



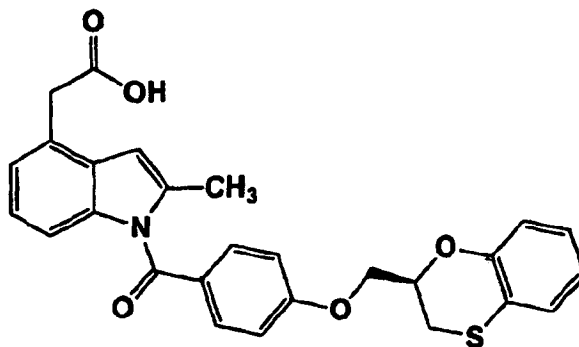
TLC:Rf 0.52 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.72 (d, J = 8.7 Hz, 2H), 7.09-6.90 (m, 5H), 6.83-6.72 (m, 1H), 6.59-6.40 (m, 3H), 4.78-4.65 (m, 1H), 4.40-4.20 (m, 2H), 3.87 (s, 2H), 3.50-3.30 (m, 2H), 2.94 (s, 3H), 2.44 (s, 3H).

Example 2(18)

1-(4-((2R)-1,4-benzoxathian-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0195]

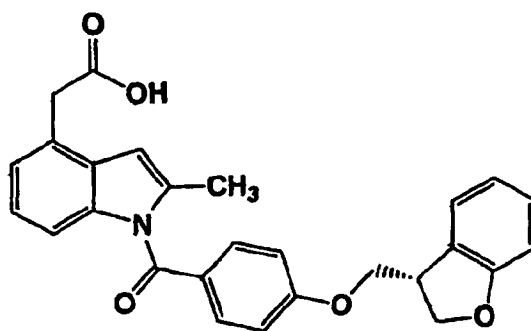


TLC:Rf 0.40 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.75-7.69 (m, 2H), 7.10-6.86 (m, 9H), 6.50 (s, 1H), 4.72- 7.65 (m, 1H), 4.40-4.22 (m, 2H), 3.87 (s, 2H), 3-2,3-3.21 (m, 2H), 2.45 (s, 3H).Example 2(19)

1-(4-((3S)-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0196]



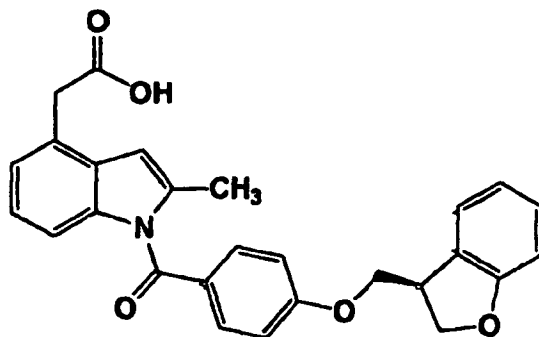
TLC:Rf 0.40 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.71 (d, J = 8.7 Hz, 2H), 7.31 (d, J = 7.5 Hz, 1H), 7-2,3-7.17 (m, 1H), 7.07-6.84 (m, 7H), 6.49 (s, 1H), 4.73 (t, J = 9.0 Hz, 1H), 4.55 (dd, J = 9.0, 4.8 Hz, 1H), 4.23 (dd, J = 8.7, 5.4 Hz, 1H), 4.10 (t, J = 8.7 Hz, 1H), 4.02-3.93 (m, 1H), 3.86 (s, 2H), 2.44 (s, 3H).

Example 2(20)

1-(4-((3R)-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0197]



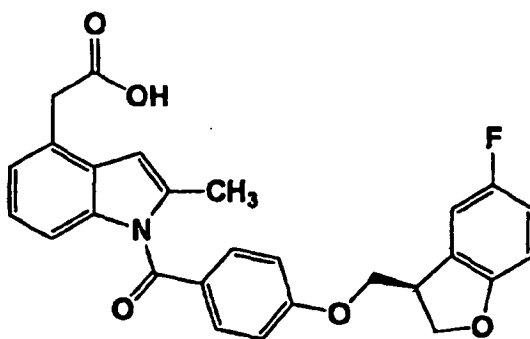
TLC:Rf 0.40 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.71 (d, J = 8.7 Hz, 2H), 7.31 (d, J = 7.5 Hz, 1H), 7.2-7.17 (m, 1H), 7.07-6.84 (m, 7H), 6.49 (s, 1H), 4.73 (t, J = 9.0 Hz, 1H), 4.55 (dd, J = 9.0, 4.8 Hz, 1H), 4.23 (dd, J = 8.7, 5.4 Hz, 1H), 4.10 (t, J = 8.7 Hz, 1H), 4.02-3.93 (m, 1H), 3.86 (s, 2H), 2.44 (s, 3H).

Example 2(21)

1-(4-((3R)-5-fluoro-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0198]



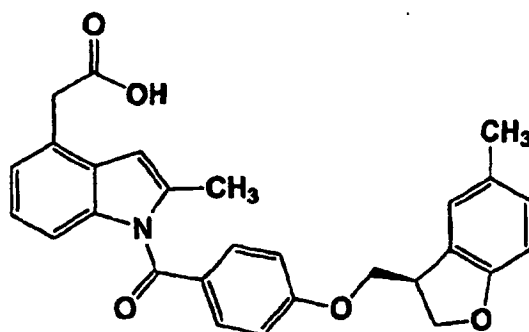
TLC:Rf 0.37 (methanol:chloroform=1:8);

NMR(CDCl₃): δ 7.71 (d, J = 9.0 Hz, 2H), 7.22-7.10 (m, 1H), 7.10-6.85 (m, 5H), 6.75-6.55 (m, 2H), 6.48 (s, 1H), 4.82-4.60 (m, 2H), 4.50-4.33 (m, 1H), 4.20-4.00 (m, 2H), 3.85 (s, 2H), 2.44 (s, 3H).

Example 2(22)

1-(4-((3R)-5-methyl-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0199]



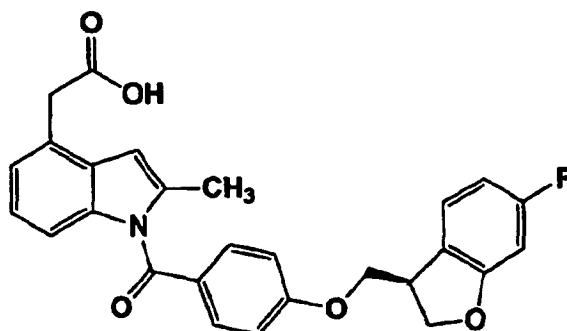
TLC:Rf 0.25 (methanol:chloroform=1:8);

NMR(CDCl₃): δ 7.71 (d, J = 9.0 Hz, 2H), 7.10 (s, 1H), 7.07-6.87 (m, 4H), 6.73 (d, J = 8.4 Hz, 2H), 6.49 (s, 1H), 4.70 (t, J = 9.0 Hz, 1H), 4.70 (t, J = 9.0 Hz, 1H), 4.53 (dd, J = 9.0, 4.8 Hz, 1H), 4.22 (dd, J = 8.7, 5.4 Hz, 1H), 4.08 (t, J = 8.7 Hz, 1H), 3.92 (m, 1H), 3.86 (s, 2H), 2.44 (s, 3H), 2.30 (s, 3H).

Example 2(23)

1-(4-((3R)-6-fluoro-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0200]



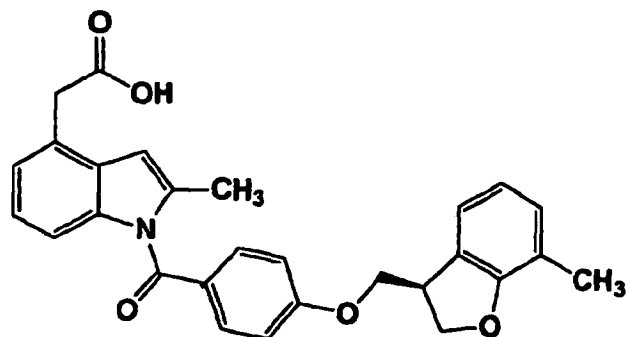
TLC:Rf 0.55 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.70 (dd, J = 6.9, 1.8 Hz, 2H), 7.20-7.10 (m, 1H), 7.05-6.90 (m, 5H), 6.70-6.55 (m, 2H), 6.48 (s, 1H), 4.75 (dd, J = 9.3, 8.1 Hz, 1H), 4.65 (dd, J = 9.3, 4.5 Hz, 1H), 4.41 (m, 1H), 4.18-4.08 (m, 2H), 3.84 (s, 2H), 2.43 (s, 3H).

Example 2(24)

1-(4-((3R)-7-methyl-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0201]



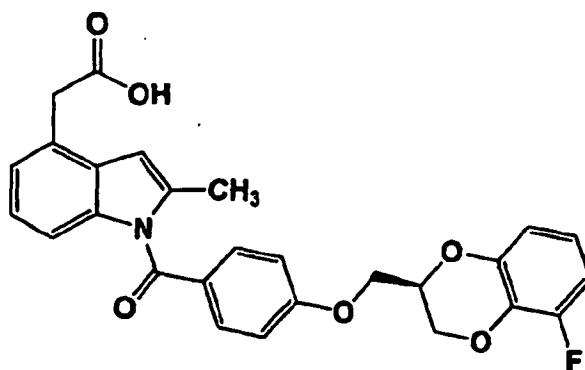
TLC:Rf 0.45 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.70 (d, J = 8.7 Hz, 2H), 7.12 (d, J = 6.9 Hz, 1H), 7.03-6.93 (m, 6H), 6.81 (t, J = 7.2 Hz, 1H), 6.47 (s, 1H), 4.71 (dd, J = 9.6, 8.7 Hz, 1H), 4.54 (dd, J = 9.6, 5.1 Hz, 1H), 4.21 (dd, J = 9.3, 5.7 Hz, 1H), 4.08 (dd, J = 9.3, 9.1 Hz, 1H), 3.97 (m, 1 H), 3.84 (s, 2H), 2.43 (s, 3H), 2.23 (s, 3H).

Example 2(25)

1-(4-((2R)-5-fluoro-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0202]



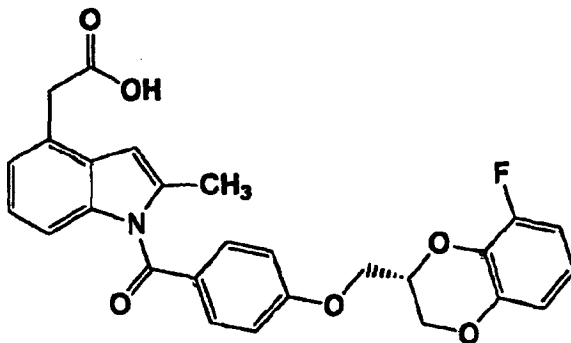
TLC:Rf 0.31 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.72 (d, J = 8.7 Hz, 2H), 7.13-6.88 (m, 5H), 6.85-6.65 (m, 3H), 6.49 (s, 1H), 4.68-4.59 (m, 1H), 4.48 (dd, J = 11.4, 2.4 Hz, 1H), 4.42-4.22 (m, 3H), 3.85 (s, 2H), 2.44 (s, 3H).

Example 2(26)

1-(4-((2S)-8-fluoro-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0203]

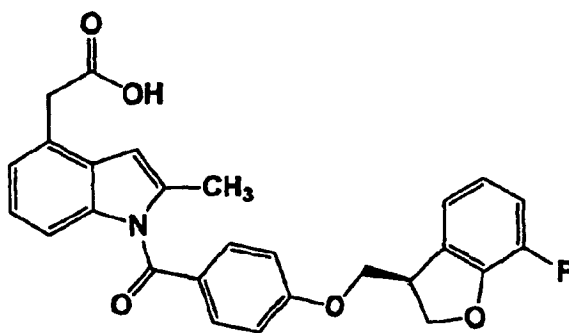


TLC:Rf 0.31 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.71 (d, J = 8.4 Hz, 2H), 7.13-6.87 (m, 5H), 6.87-6.60 (m, 3H), 6.49 (s, 1H), 4.71-4.59 (m, 1H), 4.53-4.22 (m, 4H), 3.85 (s, 2H), 2.44 (s, 3H).Example 2(27)

1-(4-((3R)-7-fluoro-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0204]



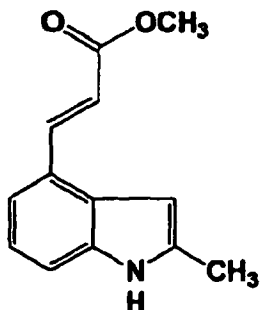
TLC:Rf 0.55 (chloroform: methanol=10:1);

NMR(CDCl₃): δ 7.70 (dd, J = 6.9, 2.1 Hz, 2H), 7.09-6.93 (m, 7H), 6.84 (m, 1H), 6.48 (s, 1H), 4.82 (t, J = 9.3 Hz, 1H), 4.64 (dd, J = 9.3, 5.4 Hz, 1H), 4.23 (dd, J = 8.7, 5.7 Hz, 1H), 4.15-4.08 (m, 1H), 4.01 (m, 1H), 3.84 (s, 2H), 2.43 (s, 3H).

Reference example 13

3-(2-methyl-1H-indol-4-yl)acrylic acid methyl ester

[0205]



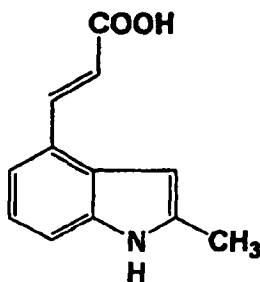
[0206] Acrylic methylester (2.24ml), diisopropyl ethylamine (5.9ml, and bis(triphenylphosphine) palladium (II) dichloride (238mg) were added to N, N-dimethylformamide (50ml) solution containing the compound (3.2g) prepared according to reference example 1, which was stirred for 2 days at 95°C. Water and ethyl acetate were added to the reaction solution, and separated. The water layer is extracted by ethyl acetate, the mixed organic layer was sequentially washed with water and saturated brine and dried, and then concentrated by vacuum concentration. The residue was purified by silica gel column chromatography (hexane:ethyl acetate=9:1) to give a compound (950g) having the following physical properties.

TLC:Rf 0.50 (hexane:ethyl acetate=8:2);

Reference example 14

3-(2-methyl-1H-indol-4-yl)acrylic acid

[0207]



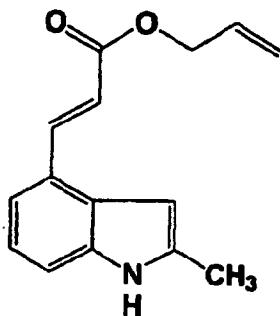
[0208] The compound (950mg) prepared according to reference example 13 was dissolved to the mixture of methanol (10ml) and tetrahydrofuran (10ml), and 5N sodium hydroxide solution (5ml) was added to the mixture, which was stirred for 3 days at room temperature. 1N hydrochloric acid was added to the reactive mixture, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine and dried. After removal of the solvent, a compound having the following physical properties was obtained. The obtained title compound was used for the following reaction without further purification.

TLC:Rf 0.54 (chloroform: methanol=9:1);

Reference example 15

3-(2-methyl-1H-indol-4-yl)acrylic acid allyl ester

[0209]



[0210] Under argon gas, potassium carbonate (553mg) and allyl chloride (0.24ml) were added to N, N-dimethylformamide (5ml) solution containing the compound (500mg) prepared according to reference example 14, which was stirred for 3.5 hours at 80°C. The reaction mixture was radiationally cooled and water was added to it, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine and dried. After removal of the solvent, the compound having the following physical properties was obtained. The residue was purified by silica gel column chromatography (hexane:ethyl acetate=4:1) to give the title compound having the following physical properties.

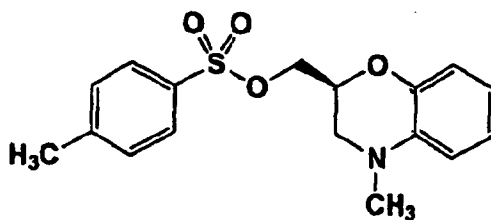
TLC:Rf 0.29 (hexane:ethyl acetate=4:1);

NMR(CDCl₃): δ 8.13-8.00 (m, 2H), 7.37-7.29 (m, 2H), 7.12 (t, J = 8.1 Hz, 1H), 6.61 (d, J = 15.9 Hz, 1H), 6.53 (brs, 1H), 6.10-5.95 (m, 1H), 5.45-5.35 (m, 1H), 5.33-5.25 (m, 1H), 4.74 (d, J = 5.7 Hz, 2H), 2.50 (s, 3H).

Reference example 16

(2S)-4-Methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethyl-4-methylbenzenesulfonate

[0211]



[0212] Under argon gas, the compound (3.06g) prepared according to reference example 12 was dissolved to tetrahydrofuran (9ml), and triethylamine (5ml) was added. Tetrahydrofuran (9ml) solution containing p-toluenesulfonic acid chloride (3.42g), and N, N-dimethylaminopyridine (209mg) were added to the reaction solution, which was stirred for 4 hours at room temperature. After adding water, to the reaction solution was extracted by the tert-butyl methyl ether. The organic layer was concentrated and the obtained residue was solidified by adding isopropyl alcohol. The solid filtrated by the filtration was dried and washed by isopropyl alcohol to give a title compound (5.12g) having the following physical properties values.

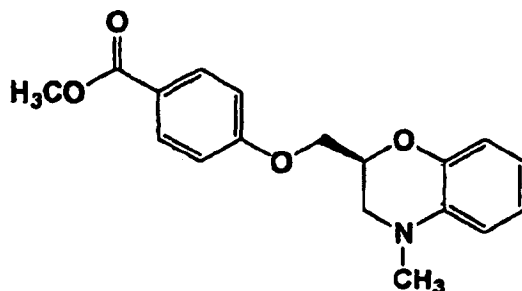
TLC:Rf 0.81 (hexane:ethyl acetate=1:1);

NMR(CDCl₃): δ 7.80 (d, J = 8.2 Hz, 2H), 7.34 (d, J = 8.2 Hz, 2H), 7.25-7.15 (m, 1H), 6.83 (m, 1H), 6.67-6.61 (m, 2H), 4.45 (m, 1H), 4.19-4.15 (m, 2H), 3.24 (dd, J = 11.6, 2.8 Hz, 1H), 3.08 (dd, J = 11.6, 6.0 Hz, 1H), 2.82 (s, 3H), 2.45 (s, 3H).

Reference example 17

4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy) benzoic acid methyl ester

[0213]



[0214] Under argon gas, the compound (3g) prepared according to reference example 16 and 4-hydroxybenzoate methyl (1.37g) were dissolved in N, N-dimethylformamide (6ml), and potassium carbonate (2.74g) was added to the solution, which was stirred for 14 hours at 80°C. The reaction mixture was radiationally cooled and tert-butylmethylether and water are added to it, which was extracted. The organic layer was concentrated to give a title compound (3.22g) having the following physical properties values.

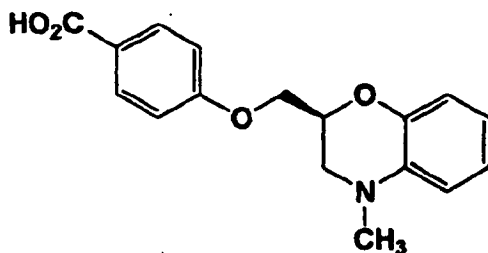
TLC:Rf 0.62 (hexane:ethyl acetate=2:1);

NMR(CDCl₃): δ 7.99 (d, J = 9.0 Hz, 2H), 6.96 (d, J = 9.0 Hz, 2H), 6.94-6.79 (m, 2H), 6.70 (d, J = 7.5 Hz, 1H), 6.68 (t, J = 7.5 Hz, 1H), 4.65 (m, 1H), 4.27 (dd, J = 9.9, 4.8 Hz, 1H), 4.17 (dd, J = 9.9, 6.6 Hz, 1H), 3.89 (s, 3H), 3.39 (dd, J = 11.7, 2.7 Hz, 1H), 3.25 (dd, J = 11.7, 6.6 Hz, 1H), 2.90 (s, 3H).

Reference example 18

4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy) benzoic acid

[0215]



[0216] The compound (420mg) prepared according to reference example 17 was dissolved to the mixture of tetrahydrofuran (1.2ml) and isopropyl alcohol (1.2ml), 4N sodium hydroxide solution (0.67ml) was added to the mixture, which was stirred for 3.5 hours at 80°C. Concentrated hydrochloric acid was added to the reaction solution, and then water was added. Further, the extracted solid was obtained by the filtration and washed by water, and then dried to give a title compound (326mg) having the following physical properties values.

TLC:Rf 0.13 (ethyl acetate:hexane=1:2);

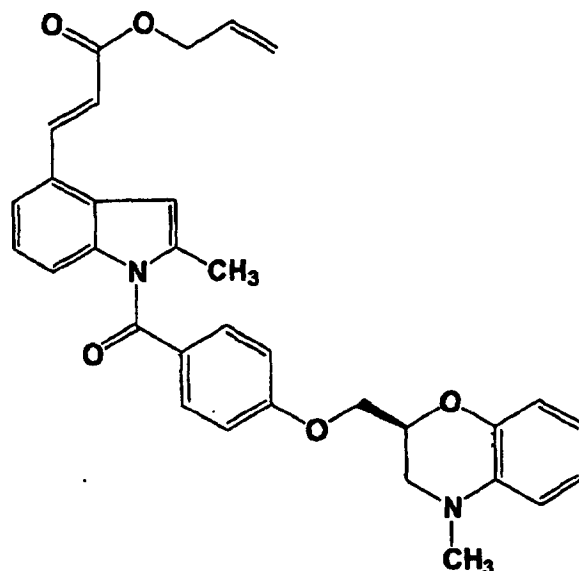
NMR(DMSO-d₆): δ 7.89 (d, J = 8.7 Hz, 2H), 7.05 (d, J = 8.7 Hz, 2H), 6.78 (t, J = 7.2 Hz, 1H), 6.70-6.68 (m, 2H), 6.58

(t, J = 7.2 Hz, 1H), 4.57 (m, 1H), 4.23 (d, J = 5.4 Hz, 2H), 3.35 (dd, J = 11.7, 2.7 Hz, 1H), 3.16 (dd, J = 11.7, 7.5 Hz, 1H), 2.82 (s, 3H).

Example 3

3-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acrylic acid allyl ester

[0217]



[0218] Under argon gas, oxalyl chloride (2.75ml) was added to 1, 2-dimethoxyethane (21.7ml) solution containing the compound (5g) prepared according to reference example 18, which stirred at 40°C for 1 hour. Acid chloride was obtained by the concentration of the reaction solution. Under argon gas, benzyltriethylammonium chloride (19mg), the above acid chloride (351mg), and sodium hydroxide (166mg) were added to dichloromethane (4ml) solution containing the compound (200mg) prepared according to reference example 15, which was stirred at room temperature for 1 hour. Water is added to the reactive mixture, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine, and then dried by anhydrous sodium sulfate. The residue obtained by removal of the solvent was purified by silica gel column chromatography (toluene: ethyl acetate=99:1 to 98:2) to give a title compound (375mg) having the following physical properties.

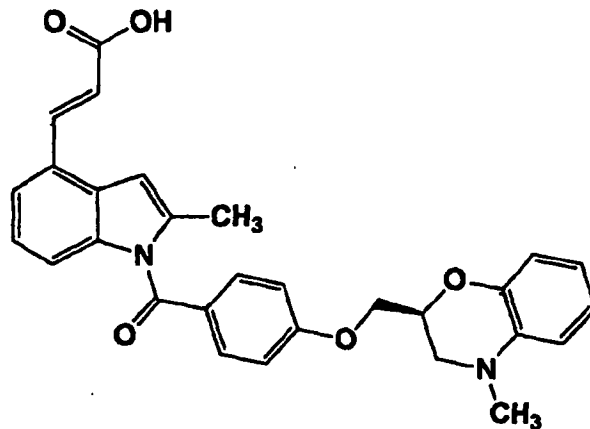
TLC:Rf 0.55 (toluene: ethyl acetate=9:1);

NMR(CDCl₃): δ 8.07 (d, J = 15.9 Hz, 1H), 7.72 (d, J = 9.0 Hz, 2H), 7.45-6.80 (m, 7H), 6.75-6.65 (m, 3H), 6.59 (d, J = 15.9 Hz, 1H), 6.10-5.95 (m, 1H), 5.45-5.35 (m, 1H), 5.33-5.25 (m, 1H), 4.75 (d, J = 5.7 Hz, 2H), 4.73-4.63 (in, 1H), 4.32 (dd, J = 9.6, 5.1 Hz, 1H), 4.22 (dd, J = 9.6, 6.3 Hz, 1H), 3.41 (dd, J = 11.7, 2.7 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H), 2.47 (s, 3H).

Example 4

3-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acrylic acid

[0219]



[0220] Under argon gas, tetrakis(triphenylphosphine) palladium (0) (79mg) was added to tetrahydrofuran (5ml) solution containing the compound (375mg) prepared according to reference example 20, which was stirred for 10 minutes. Morpholine (0.30ml) was added to the reaction solution, which was stirred for 1.5 hours at room temperature. 1N hydrochloric acid was added to the reactive mixture, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine, and then dried by anhydrous sodium sulfate. The residue obtained by removal of the solvent was purified by silica gel column chromatography (chloroform: methanol=99:1) to give a title compound (375mg) having the following physical properties.

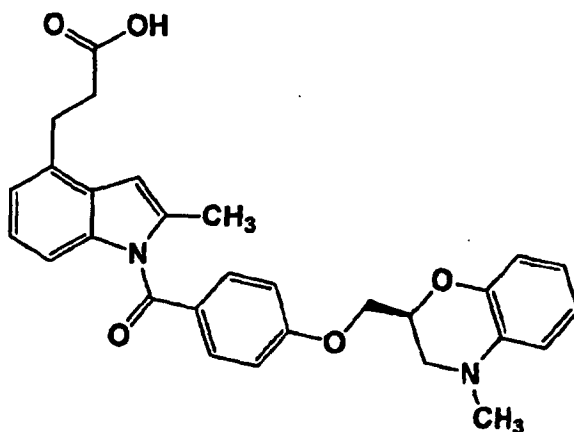
TLC:Rf 0.37 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 8.13 (d, J = 15.9 Hz, 1H), 7.72 (d, J = 9.0 Hz, 2H), 7.43 (dd, J = 6.9, 1.8 Hz, 1H), 7.13-6.98 (m, 4H), 6.94-6.82 (m, 2H), 6.76-6.67 (m, 3H), 6.58 (d, J = 15.9 Hz, 1H), 4.74-4.64 (m, 1H), 4.32 (dd, J = 9.9, 5.4 Hz, 1H), 4.22 (dd, J = 9.9, 6.0 Hz, 1H), 3.41 (dd, J = 11.7, 2.7 Hz, 1H), 3.29 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H), 2.48 (s, 3H).

Example 5

3-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)propanoic acid

[0221]



[0222] Under argon gas, the compound (230mg) prepared according to example 4 was dissolved to the mixture of ethyl acetate (7ml) and methanol (7ml), and 10% palladium carbon (90mg) was added to it, which was stirred for 1.5 hours under hydrogen gas. The reaction solution was filtered through celite (registered trademark), and the filtrate was concentrated. The obtained residue was recrystallized by methanol-water to give a title compound (90mg) having the following physical properties.

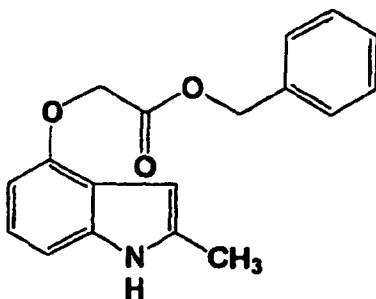
TLC:Rf 0.43 (chloroform: methanol=9:1);

NMR(CDC_l₃): δ 7.72 (d, J = 8.7 Hz, 2H), 7.05-6.80 (m, 7H), 6.76-6.66 (m, 2H), 6.49 (s, 1H), 4.74-4.64 (m, 1H), 4.31 (dd, J = 9.6, 4.8 Hz, 1H), 4.21 (dd, J = 9.6, 6.0 Hz, 1H), 3.41 (dd, J = 12.0, 3.0 Hz, 1H), 3.28 (dd, J = 12.0, 6.6 Hz, 1H), 3.19 (t, J = 8.1 Hz, 2H), 2.92 (s, 3H), 2.78 (t, J = 8.1 Hz, 2H), 2.45 (s, 3H).

Reference example 19

2-methyl-1H-indol-4-ylloxyphenylmethyl acetic acid benzyl ester

[0223]



[0224] Under argon gas, potassium carbonate (2.14g) and bromoacetic acid benzyl (1.08ml) were added to N, N-

dimethyl formamide (10ml) solution containing 4-hydroxy-2-methyl-1H-indole (612mg), which was stirred at 60°C for 1 hour. Water was added to the reactive mixture, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine, and then dried by anhydrous sodium sulfate. The residue obtained by removal of the solvent was recrystallized by ethylacetate-hexane to give a title compound (1.3g) having the following physical properties.

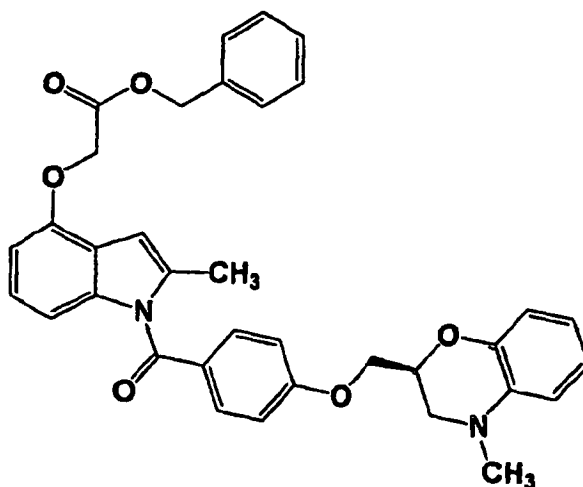
TLC:Rf 0.45 (hexane: ethyl acetate=7:3);

NMR(CDCl₃): δ 7.87 (brs, 1H), 7.40-7.30 (m, 5H), 7.01-6.94 (m, 2H), 6.44-6.36 (m, 2H), 5.25 (s, 2H), 4.80 (s, 2H), 2.43 (s, 3H).

Example 6

(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-yl)methoxy)benzoyl)-2-methyl-1H-indol-4-yl)oxyacetic acid benzyl ester

[0225]



[0226] Instead of the compound prepared according to reference example 15, using the compound prepared according to reference example 19, a compound of the present invention having the following physical properties values was obtained by an operation similar to the method represented by example 3.

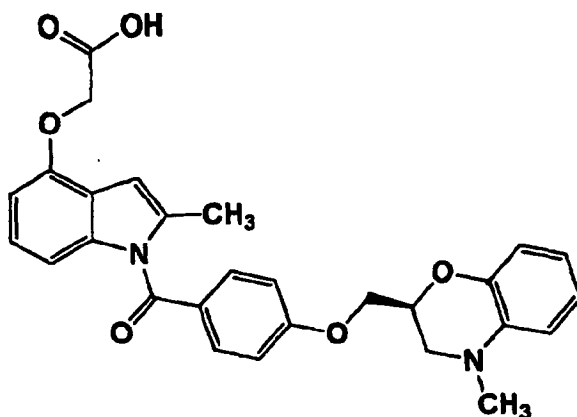
TLC:Rf 0.60 (toluene: ethyl acetate=9:1);

NMR(CDCl₃): δ 7.71 (d, J=9.0 Hz, 2H), 7.40-7.30 (m, 5H), 7.30-6.60 (m, 10H), 5.25 (s, 2H), 4.79 (s, 2H), 4.75-4.65 (m, 1H), 4.31 (dd, J = 9.9, 5.4 Hz, 1H), 4.21 (dd, J = 9.6, 6.3 Hz, 1H), 3.41 (dd, J = 11.4, 2.7 Hz, 1H), 3.28 (dd, J = 11.4, 6.6 Hz, 1H), 2.92 (s, 3H), 2.42 (s, 3H).

Example 7

(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)oxyacetic acid

[0227]



[0228] Under argon gas, 20% hydroxide palladium (40mg) was added to ethyl acetate (10ml) solution containing the compound (130mg) prepared according to example 6, which was stirred for 80 minutes at room temperature under hydrate gas. The reaction solution was filtered through celite (registered trademark), and the filtrate was concentrated. The obtained residue was purified by silica gel column chromatography (chloroform: methanol=99:1) to give a title compound (75mg) having the following physical properties.

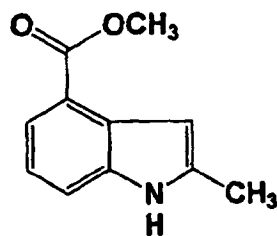
TLC:Rf 0.23 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.71 (d, J = 8.7 Hz, 2H), 7.06-6.81 (m, 5H), 6.76-6.66 (m, 3H), 6.59 (s, 1H), 6.52 (d, J = 8.1 Hz, 1H), 4.80 (s, 2H), 4.73-4.62 (m, 1H), 4.31 (dd, J = 9.9, 5.1 Hz, 1H), 4.21 (dd, J = 9.9, 6.3 Hz, 1H), 3.41 (dd, J = 11.4, 2.7 Hz, 1H), 3.28 (dd, J = 11.4, 6.3 Hz, 1H), 2.92 (s, 3H), 2.43 (s, 3H).

Reference example 20

2-methyl-1H-indole-4-carboxylic acid methyl ester

[0229]



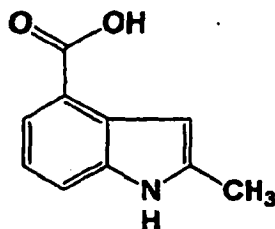
[0230] Triethylamine (6.3ml) and tetrakis(triphenylphosphine) palladium (0) (2.6g) were added to methanol (33.43ml) -N, N-dimethyl formamide (200ml) solution containing the compound (6.32g) prepared according to reference example 1. The reactor was filled with carbon monoxide, and the reaction solution was stirred at 60°C over night. Water and ethyl acetate was added to the reaction solution, which was extracted. The water layer was extracted by ethyl acetate and the mixed organic layer was sequentially washed with water and saturated brine and dried, and then concentrated by vacuum concentration. The residue was purified by silica gel column chromatography (hexane: ethyl acetate=85:

1) to give a title compound (4.29mg) having the following physical properties.
TLC:Rf 0.18 (toluene);

Reference example 21

2-methyl-1H-indole-4-carboxylic acid

[0231]



[0232] 5N sodium hydroxide solution (10ml) was added to methanol dioxane(10ml+10ml) solution containing the compound (4.3g) prepared according to reference example 20, which was stirred at 60°C over night. 2N hydrochloric acid was added to the reaction solution, which was extracted by ethyl acetate. The water layer was extracted by ethyl acetate and the mixed organic layer was sequentially washed with water and saturated brine and dried, and then concentrated by vacuum concentration. The residue was purified by silica gel column chromatography (chloroform: methanol=85:1) to give a title compound (1.6g) having the following physical properties.

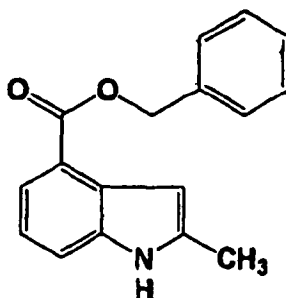
TLC:Rf0.48 (chloroform: methanol=9:1);

NMR(CDCl₃):δ 8-1,4-8.04 (br, 1H), 7.94 (dd, J = 7.5, 0.9 Hz, 1H), 7.52 (m, 1H), 7.18 (t, J = 7.5 Hz, 1H), 6.94 (m, 1H), 2.52 (s, 3H).

Reference example 22

2-methyl-1H-indole-4-carboxylic acid benzyl ester

[0233]



[0234] At room temperature, anhydrous potassium carbonate (1.02g) and benzyl bromide (0.49ml) were added to N, N-dimethyl formamide (7ml) solution containing the compound (650mg) prepared according to reference example 21, which was stirred for 4 hours at room temperature. Water and ethyl acetate are added to the reaction solution, which was extracted. The water layer was extracted by ethyl acetate and the mixed organic layer was sequentially washed with water and saturated brine and dried, and then concentrated by vacuum concentration. The residue was purified by silica gel column chromatography (hexane:ethyl acetate=85:1) to give a title compound (600mg) having the following physical properties.

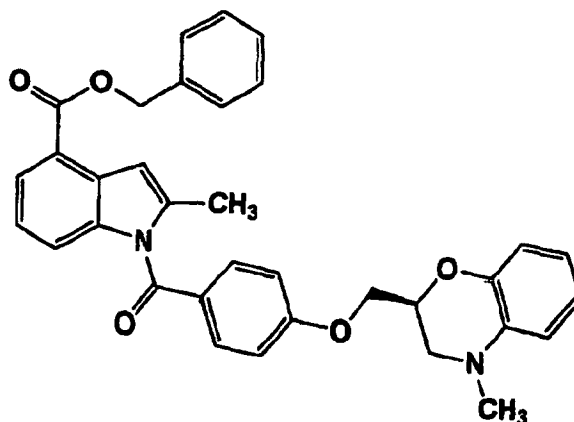
TLC:Rf 0.44 (hexane:ethyl acetate=8:2);

NMR(CDCl₃): δ 8.05 (brs, 1H), 7.91 (d, J = 7.5 Hz, 1H), 7.54-7.10 (m, 7H), 6.88 (s, 1H), 5.44 (s, 2H), 2.48 (s, 3H).

Example 8

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-carboxylic acid benzyl ester

[0235]



[0236] Using the compound prepared according to reference example 22 instead of the compound prepared according to reference example 15, a compound of the present invention having the following physical properties values was obtained by an operation similar to the method represented by example 3.

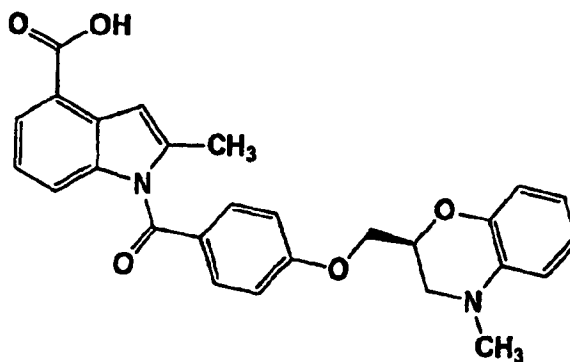
TLC:Rf 0.58 (hexane:ethyl acetate=7:3);

NMR(CDCl₃): δ 7.93 (d, J = 8.1 Hz, 1H), 7.69 (d, J=8.7Hz, 2H), 7.54-7.24 (m, 6H), 7.12-6.96 (m, 4H), 6.92-6.80 (m, 2H), 6.74-6.66 (m, 2H), 5.44 (s, 2H), 4.74-4.62 (m, 1H), 4.31 (dd, J = 9.9, 5.1 Hz, 1H), 4.21 (dd, J = 9.9, 6.0 Hz, 1H), 3.37 (dd, J = 11.7, 3.0 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H), 2.43 (s, 3H).

Example 9

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-carboxylic acid

[0237]



[0238] Using the compound prepared according to reference example 8 instead of the compound prepared according to reference example 6, a compound of the present invention having the following physical properties values was obtained by an operation similar to the method represented by example 7.

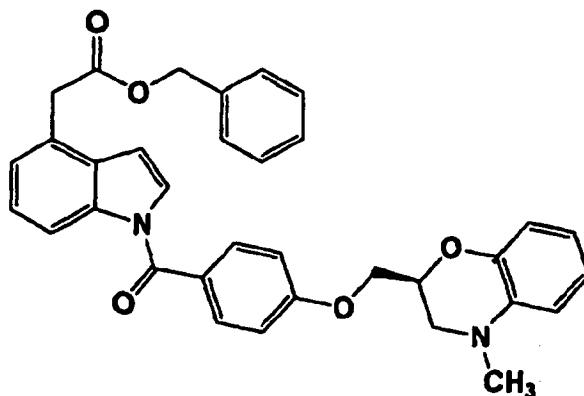
TLC:Rf 0.55 (chloroform: methanol=9:1);

5 NMR(CDCl₃): δ 7.97 (d, J = 7.8 Hz, 1H), 7.71 (d, J = 8.7 Hz, 2H), 7.34 (d, J = 7.8 Hz, 1H), 7.20 (s, 1H), 7.12 (t, J = 7.8 Hz, 1H), 7.02 (d, J = 8.7 Hz, 2H), 6.95-6.80 (m, 2H), 6.75-6.65 (m, 2H), 4.75-4.65 (m, 1H), 4.32 (dd, J = 9.6, 4.8 Hz, 1H), 4.23 (dd, J = 9.6, 6.3 Hz, 1H), 3.41 (dd, J = 11.7, 3.0 Hz, 1H), 3.29 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H), 2.47 (s, 3H).

Example 10

10 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-1H-indol-4-yl acetic acid benzyl ester

[0239]



[0240] Using 4-hydroxy-1H-indole instead of 2-methyl-4-hydroxy-1H-indole, a compound of the present invention having the following physical properties values was obtained by an operation similar to a method sequentially represented by reference example 1, reference example 2, reference example 3, reference example 4, reference example 5, reference example 6, reference example 7, reference example 8, and example 1.

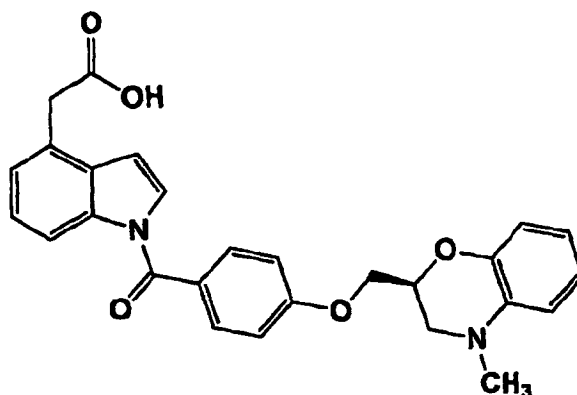
TLC:Rf 0.22 (hexane: ethyl acetate=3:1);

35 NMR(CDCl₃): δ 8.26 (d, J = 8.1 Hz, 1H), 7.74 (d, J = 9.0 Hz, 2H), 7.40-7.25 (m, 7H), 7.21 (d, J = 8.1 Hz, 1H), 7.05 (d, J = 9.0 Hz, 2H), 7.25-7.00 (m, 2H), 6.75-6.64 (m, 3H), 5.13 (s, 2H), 4.68 (m, 1H), 4.32 (dd, J = 9.9, 4.8 Hz, 1H), 4.21 (dd, J = 9.9, 6.3 Hz, 1H), 3.93 (s, 2H), 3.41 (dd, J = 11.7, 3.0 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H).

Example 11

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-1H-indol-4-yl acetic acid

[0241]



[0242] Using the compound prepared according to reference example 10 instead of the compound prepared according to reference example 6, a compound of the present invention having the following physical properties values was obtained by an operation similar to the method represented by example 7.

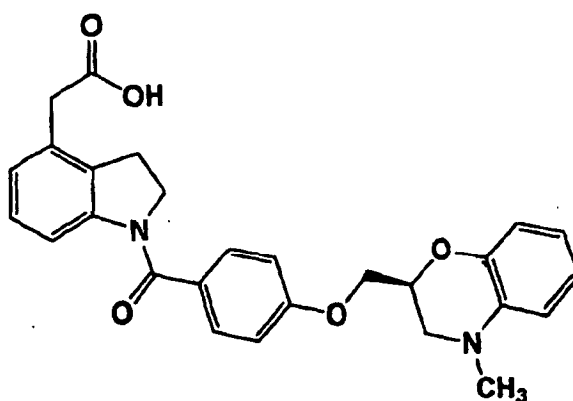
TLC:Rf 0.33 (ethyl acetate: hexane=2:1);

NMR(CDCl₃): δ 8.27 (d, J = 8.1 Hz, 2H), 7.73 (d, J = 8.7 Hz, 2H), 7.37 (d, J = 3.9 Hz, 1H), 7.33 (t, J = 7.8 Hz, 1H), 7.21 (d, J = 6.6 Hz, 1H), 7.05 (d, J = 8.7 Hz, 2H), 6.93-6.80 (m, 2H), 6.77-6.63 (m, 3H), 4.73-4.63 (m, 1H), 4.31 (dd, J = 9.9, 5.1 Hz, 1H), 4.21 (dd, J = 9.9, 6.0 Hz, 1H), 3.90 (s, 2H), 3.40 (dd, J = 11.7, 2.7 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H).

Example 12

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2,3-dihydro-1H-indol-4-yl acetic acid

[0243]



[0244] Under argon gas, the compound (0.67g) prepared according to example 10 was dissolved to ethyl acetate (5ml) and hydroxide palladium (500mg) were added to the mixture, which was stirred for 2 days at room temperature under hydrate gas. The reaction solution was filtered through celite (registered trademark), and the filtrate was concentrated. The residue was purified by silica gel column chromatography (ethyl acetate: hexane=3:2) to give a title compound (0.19g) having the following physical properties.

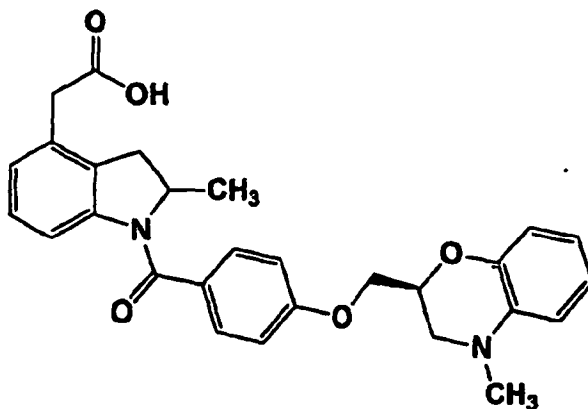
TLC:Rf 0.10 (ethyl acetate: hexane=2:1);

NMR(DMSO- d_6): δ 7.88-7.25 (m, 3H), 7.20-6.96 (m, 3H), 6.90 (d, J = 7.2 Hz, 1H), 6.84-6.67 (m, 3H), 6.61 (td, J = 6.9, 1.8 Hz, 1H), 4.60 (m, 1H), 4.26 (d, J = 4.8 Hz, 2H), 4.05 (t, J = 8.4 Hz, 2H), 3.54 (s, 2H), 3.50-3.10 (m, 4H), 3.02 (t, J = 8.4 Hz, 2H), 2.85 (s, 3H).

Example 13

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-2,3-dihydro-1H-indol-4-yl acetic acid

[0245]



[0246] Under argon gas, the compound (200mg) prepared according to example 2 was dissolved to the mixture of ethyl acetate (10ml) and methanol (10ml), and 10% palladium carbon (60mg) was added. Under hydrate gas, the reactive mixture was violently stirred for 2 days at room temperature. The reaction solution was filtered through celite (registered trademark), and the filtrate was concentrated. The residue was purified by silica gel column chromatography (chloroform: methanol=199:1 to 99:1) to give a title compound (30mg) having the following physical properties.

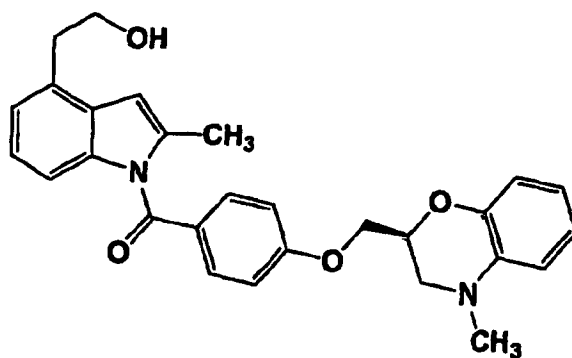
TLC:Rf 0.41 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.49 (d, J = 8.4 Hz, 2H), 7.08-6.80 (m, 7H), 6.76-6.66 (m, 2H), 4.84-4.70 (m, 1H), 4.70-4.60 (m, 1H), 4.29 (dd, J = 9.6, 5.1 Hz, 1H), 4.15 (dd, J = 9.6, 6.6 Hz, 1H), 3.61 (s, 2H), 3.44-3.22 (m, 3H), 2.91 (s, 3H), 2.65 (dd, J = 15.9, 2.1 Hz, 1H), 1.30-1.20 (m, 3H).

Example 14

2-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol

[0247]



[0248] Under argon gas, the compound (420mg) prepared according to example 2 was dissolved to tetrahydrofuran (20ml), cold borane-tetrahydrofuran complex (1M, 2.7ml) was added to the mixture, which was stirred at 10°C for 2 hours. The reaction solution was poured into ice, and 1N hydrochloric acid added to the solution, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine, and then dried by anhydrous sodium sulfate. The residue obtained by removal of the solvent was purified by silica gel column chromatography (ethyl acetate: hexane=2:3 to 1:1) to give a title compound (341mg) having the following physical properties.

TLC:Rf 0.41 (ethyl acetate: hexane=2:1);

NMR(CDCl₃): δ 7.72 (d, J = 8.7 Hz, 2H), 7.04-6.77 (m, 7H), 6.77-6.60 (m, 2H), 6.50 (s, 1H), 4.72-4.60 (m, 1H), 4.31 (dd, J = 9.9, 5.1 Hz, 1H), 4.25-4.10 (m, 1H), 3.95 (t, J = 6.3 Hz, 2H), 3.40 (dd, J = 11.7, 2.7 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 3.10 (t, J = 6.3 Hz, 2H), 2.92 (s, 3H), 2.45 (s, 3H).

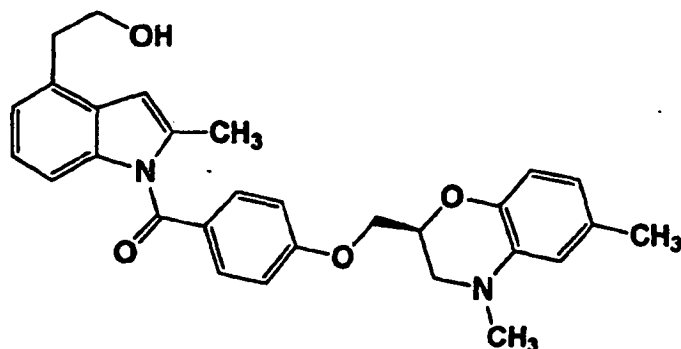
Example 14(1) to Example 14(5)

[0249] Using the compound prepared according to example 2(5), example 2(6), example 2(10), example 2(15), and example 2(20) instead of the compound prepared according to reference example 2, the compounds of the present invention having the following physical properties values were obtained by an operation similar to the method represented by example 14.

Example 14(1)

2-(1-(4-((2S)-4,6-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol

[0250]



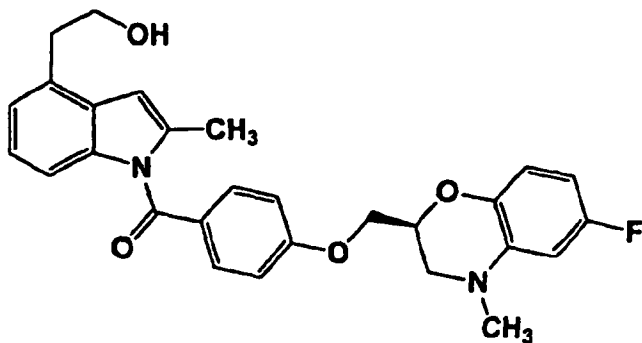
TLC:Rf 0.51 (ethyl acetate: hexane=2:1);

NMR(CDC₃) δ 7.72 (d, J = 9.0 Hz, 2H), 7.05-6.85 (m, 5H), 6.73 (d, J = 7.5 Hz, 1H), 6.56-6.44 (m, 3H), 4.70-4.60 (m, 1H), 4.30 (dd, J = 9.9, 5.4 Hz, 1H), 4.20 (dd, J = 9.9, 6.3 Hz, 1H), 4.00-3.90 (m, 2H), 3.39 (dd, J = 11.4, 2.7 Hz, 1H), 3.26 (dd, J = 11.4, 6.6 Hz, 1H), 3.10 (t, J = 6.3 Hz, 2H), 2.90 (s, 3H), 2.45 (s, 3H), 2.28 (s, 3H), 1.48-1.38 (m, 1H).

Example 14(2)

2-(1-(4-((2S)-6-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol

[0251]



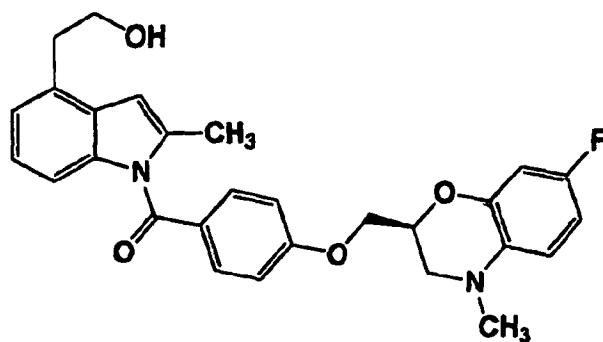
TLC:Rf 0.49 (ethyl acetate: hexane=2:1);

NMR(CDC₃) δ 7.72 (d, J = 8.1 Hz, 2H), 7.04-6.86 (m, 5H), 6.74 (dd, J = 8.4, 5.4 Hz, 1H), 6.50 (s, 1H), 6.45-6.30 (m, 2H), 4.66-4.56 (m, 1H), 4.30 (dd, J = 9.9, 5.1 Hz, 1H), 4.19 (dd, J = 9.9, 6.3 Hz, 1H), 4.00-3.90 (m, 2H), 3.41 (dd, J = 11.4, 2.7 Hz, 1H), 3.30 (dd, J = 11.4, 6.9 Hz, 1H), 3.10 (t, J = 6.3 Hz, 2H), 2.91 (s, 3H), 2.45 (s, 3H), 1.50-1.40 (m, 1H).

Example 14(3)

2-(1-(4-((2S)-7-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol

[0252]



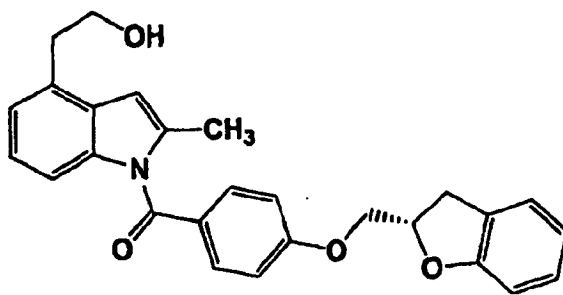
TLC:Rf 0.42 (ethyl acetate: hexane=2:1);

NMR(CDCl₃): δ 7.73 (d, J = 9.0 Hz, 2H), 7.05-6.88 (m, 5H), 6.65-6.58 (m, 3H), 6.50 (s, 1H), 4.75-4.65 (m, 1H), 4.30 (dd, J = 9.9, 5.1 Hz, 1H), 4.21 (dd, J = 9.9, 6.0 Hz, 1H), 4.00-3.90 (m, 2H), 3.36 (dd, J = 11.4, 2.7 Hz, 1H), 3.22 (dd, J = 11.4, 6.6 Hz, 1H), 3.10 (t, J = 6.3 Hz, 2H), 2.88 (s, 3H), 2.45 (s, 3H), 1.50-1.40 (m, 1H).

Example 14(4)

2-(1-(4-((2S)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol

[0253]



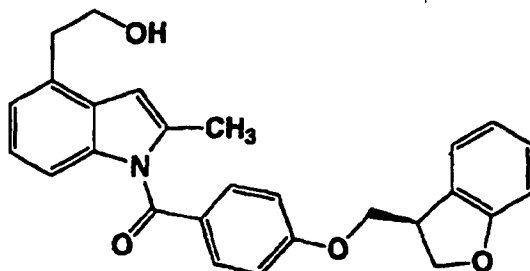
TLC:Rf 0.64 (ethyl acetate: hexane=2:1);

NMR(CDCl₃): δ 7.71 (d, J = 9.3 Hz, 2H), 7.30-7.10 (m, 2H), 7.05-6.80 (m, 7H), 6.49 (s, 1H), 5.25-5.15 (m, 1H), 4.30 (dd, J = 10.2, 6.3 Hz, 1H), 4.21 (dd, J = 10.2, 4.8 Hz, 1H), 3.95 (brq, J = 5.4 Hz, 2H), 3.43 (dd, J = 15.6, 9.6 Hz, 1H), 3.17 (dd, J = 15.6, 7.2 Hz, 1H), 3.10 (t, J = 6.3 Hz, 2H), 2.45 (s, 3H), 1.50-1.40 (m, 1H).

Example 14(5)

2-(1-(4-((3R)-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol

[0254]



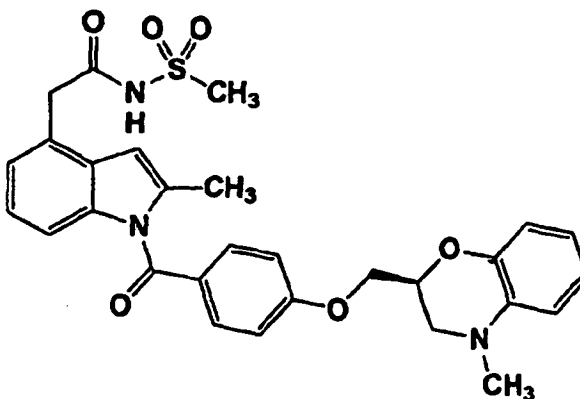
TLC:Rf 0.67 (ethyl acetate: hexane=2:1);

NMR(CDCl₃): δ 7.72 (d, J = 9.0 Hz, 2H), 7.35-7.15 (m, 2H), 7.05-6.85 (m, 7H), 6.50 (s, 1H), 4.73 (t, J = 9.0 Hz, 1H), 4.55 (dd, J = 9.0, 5.1 Hz, 1H), 4.24 (dd, J = 9.0, 5.7 Hz, 1H), 4.11 (t, J = 9.0 Hz, 1H), 4.05-3.90 (m, 3H), 3.10 (t, J = 6.6 Hz, 2H), 2.45 (s, 3H), 1.50-1.40 (m, 1H).

Example 15

N-methylsulfonyl-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acetamide

[0255]



[0256] Under argon-gas, 1-ethyl-3-[3-(dimethylamino)propyl]carbodiimide (82mg), N, N-dimethylaminopyridine (39mg), and methane sulfonamide (51mg) were added to dichloromethane (5ml) solution containing the compound (100mg) prepared according to example 2 at room temperature, which was stirred for 15 hours at room temperature. Saturated ammonium chloride solution was added to the reaction solution, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine and dried by anhydrous sodium sulfate. The residue obtained by removal of the solvent was purified by silica gel column chromatography (chloroform: methanol=100:1 to 30:1) to give a title compound (72mg) having the following physical properties.

TLC:Rf 0.40 (chloroform: methanol= 10: 1);

NMR(CDCl₃): δ 7.77-7.73 (m, 2H), 7.07-7.00 (m, 5H), 6.92-6.82 (m, 2H), 6.72 (d, J = 7.5 Hz, 2H), 6.43 (s, 1H), 4.69 (m, 1H), 4.33 (dd, J = 9.9, 5.4 Hz, 1H), 4.23 (dd, J = 9.9, 6.0 Hz, 1H), 3.92 (s, 2H), 3.41 (dd, J = 11.4, 2.7 Hz, 1H), 3.29

(dd, J = 11.4, 6.6 Hz, 1H), 3.27 (s, 3H), 2.92 (s, 3H), 2.46 (d, J = 0.9 Hz, 3H).

Example 15(1)

5 N-phenylsulfonyl-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)
acetamide

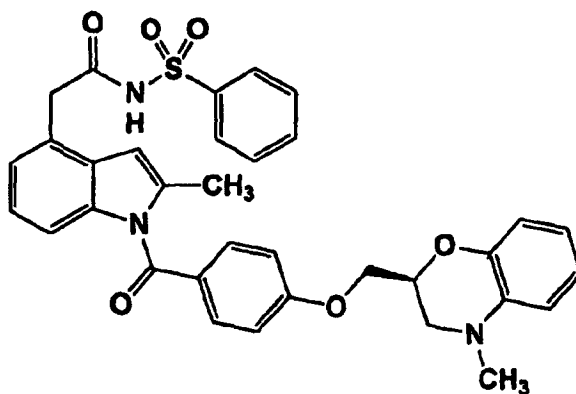
[0257]

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[0258] Using benzenesulfonamide instead of methane sulfonamide, a compound of the present invention having the following physical properties values was obtained by an operation similar to example 15.

TLC: R_f 0.58 (chloroform: methanol=9:1);

30 NMR(CDC₃Cl₃): δ 7.98-7.58 (m, 6H), 7.56-7.46 (m, 2H), 7.08-6.80 (m, 7H), 6.76-6.66 (m, 2H), 6.16 (s, 1H), 4.74-4.64 (m, 1H), 4.33 (dd, J = 9.6, 5.1 Hz, 1H), 4.23 (dd, J = 9.6, 6.3 Hz, 1H), 3.79 (s, 2H), 3.41 (dd, J = 11.4, 2.7 Hz, 1H), 3.29 (dd, J = 11.4, 6.6 Hz, 1H), 2.92 (s, 3H), 2.38 (s, 3H).

Example 16

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2-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethyl acetate

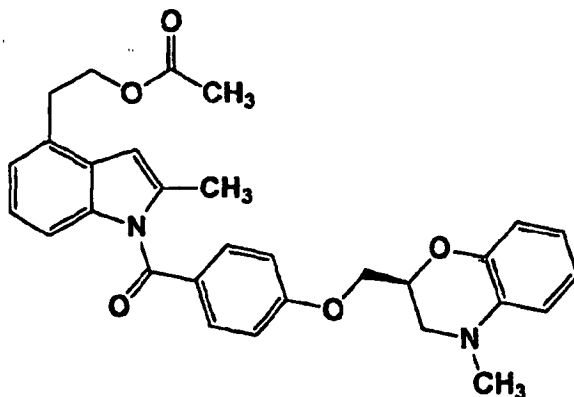
[0259]

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[0260] Under argon gas, the compound (49.3mg) prepared according to example 14 was dissolved to pyridine (3ml),

and cold acetyl chloride (38 μ l) was added to the mixture, which was stirred for 1.5 hours at 0°C. Water is added to the reaction solution, which was extracted by ethyl acetate. The organic layer was sequentially washed with saturated sodium bicarbonate solution, 1N hydrochloric acid, water, and saturated brine and dried by anhydrous sodium sulfate. After removal of the solvent, a title compound (54mg) having the following physical properties was obtained.

5 TLC:Rf 0.33 (ethyl acetate: hexane=1:2);

NMR(CDCl₃): δ 7.72 (d, J = 8.7 Hz, 2H), 7.04-6.82 (m, 7H), 6.75-6.67 (m, 2H), 6.52 (s, 1H), 4.75-4.65 (m, 1H), 4.36 (t, J = 7.2 Hz, 2H), 4.32(dd, J = 9.9, 5.1 Hz, 1H), 4.21 (dd, J = 9.9, 6.0 Hz, 1H), 3.41 (dd, J = 11.4, 3.0 Hz, 1H), 3.28 (dd, J = 11.4, 6.6 Hz, 1H), 3.16 (t, J = 7.2 Hz, 2H), 2.92 (s, 3H), 2.45 (s, 3H), 2.06 (s, 3H).

10 Reference example 23(1) to 23(11)

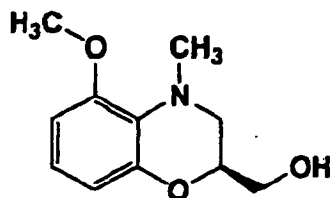
[0261] Using the corresponding aniline derivative instead of the compound prepared according to reference example 10, the compounds of the present invention having the following physical properties values were obtained by an operation similar to a method sequentially represented by reference example 11 and reference example 12.

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Reference example 23(1)

(2S)-2-hydroxymethyl-5-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

20 [0262]



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TLC:Rf 0.16 (hexane: ethyl acetate=1:1);

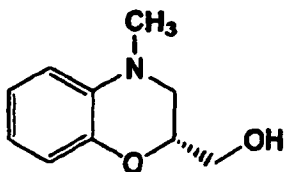
NMR(CDCl₃): δ 6.89 (t, J = 8.4 Hz, 1H), 6.57 (dd, J = 8.4, 1.5 Hz, 1H), 6.49 (dd, J = 8.4, 1.5 Hz, 1H), 4.16-4.06 (m, 1H), 3.89 (s, 3H), 3.97-3.75 (m, 2H), 3.13-2.98 (m, 2H), 2.85 (s, 3H).

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Reference example 23(2)

(2R)-2-hydroxymethyl-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

40 [0263]



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TLC:Rf 0.10 (hexane: ethyl acetate=3:1);

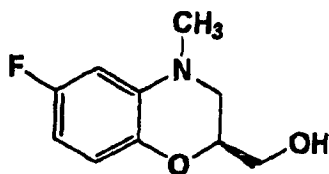
NMR(CDCl₃): δ 7.00 -6.60 (m, 4H), 4.35 (m, 1H), 4.00-3.70 (m, 2H), 3.33-3.10 (m, 2H), 2.88 (s, 3H), 2.01 (m, 1H).

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Reference example 23(3)

(2S)-2-hydroxymethyl-6-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0264]

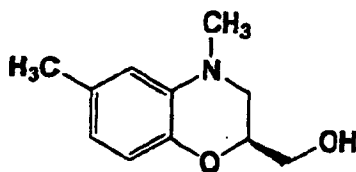


TLC:Rf 0.33 (hexane: ethyl acetate=1:1);

NMR(CDCl₃): δ 6.75-6.65 (m, 1H), 6.42-6.26 (m, 2H), 4.30-4.20 (m, 1H), 3.90-3.72 (m, 2H), 3.21 (d, J = 5.4 Hz, 2H), 2.87 (s, 3H), 2.05-1.95 (m, 1H).Reference example 23(4)

(2S)-2-hydroxymethyl-4,6-dimethyl-3,4-dihydro-2H-1,4-benzoxazine

[0265]

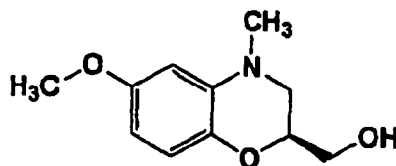


TLC:Rf 0.44 (hexane: ethyl acetate=2:1);

NMR(CDCl₃): δ 6.70 (d, J = 7.8 Hz, 1H), 6.50-6.46 (m, 2H), 4.30 (m, 1H), 3.90-3.75 (m, 2H), 3.2, 3.13 (m, 2H), 2.87 (s, 3H), 2.26 (s, 3H), 2.03 (brs, 1H).Reference example 23(5)

(2S)-2-hydroxymethyl-6-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0266]



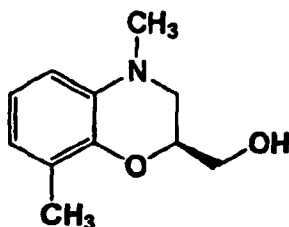
TLC:Rf 0.33 (hexane: ethyl acetate=1:1);

NMR(CDCl₃): δ 6.72 (d, J = 8.4 Hz, 1H), 6.26 (d, J = 2.7 Hz, 1H), 6.20 (dd, J = 8.4, 2.7 Hz, 1H), 4.26 (m, 1H), 3.88-3.76 (m, 2H), 3.76 (s, 3H), 3.19 (d, J = 5.4 Hz, 2H), 2.87 (s, 3H), 2.00 (t, J = 6.3 Hz, 1H).

Reference example 23(6)

(2S)-2-hydroxymethyl-4, 8-dimethyl-3,4-dihydro-2H-1,4-benzoxazine

[0267]



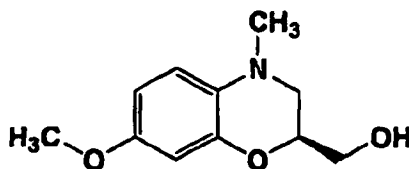
TLC:Rf 0.49 (hexane: ethyl acetate=1:1);

NMR(CDCl₃): δ 6.76 (dd, J = 7.8, 7.5 Hz, 1H), 6.56 (d, J = 7.8 Hz, 1H), 6.56 (d, J = 7.5 Hz, 1H), 4.36 (m, 1H), 3.92-3.76 (m, 2H), 3.22 (dd, J = 11.1, 3.3 Hz, 1H), 3.16 (dd, J = 11.1, 6.9 Hz, 1H), 2.87 (s, 3H), 2.19 (s, 3H), 2.03 (brs, 1H).

Reference example 23(7)

(2S)-2-hydroxymethyl-7-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0268]



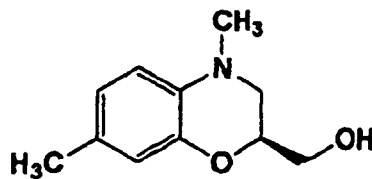
TLC:Rf 0.06 (hexane: ethyl acetate=3:1);

NMR(CDCl₃): δ 6.67-6.61 and 6.49-6.43 (m, total 3H), 4.42-4.33 (m, 1H), 3.94-3.75 (m, 2H), 3.73 (s, 3H), 3.16 (dd, J = 11.4, 3.0 Hz, 1H), 3.08 (dd, J = 11.4, 4.6 Hz, 1H), 2.82 (s, 3H).

Reference example 23(8)

(2S)-2-hydroxymethyl-4, 7-dimethyl-3,4-dihydro-2H-1,4-benzoxazine

[0269]



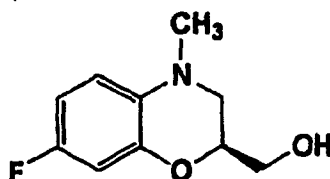
TLC:Rf 0.18 (hexane: ethyl acetate=3:1);

NMR(CDCl₃): δ 6.70-6.57 (m, 3H), 4.38-4.30 (m, 1H), 3.85 (dd, J = 11.7, 4.2 Hz, 1H), 3.79 (dd, J = 11.7, 5.7 Hz, 1H), 3.18 (dd, J = 11.7, 3.9 Hz, 1H), 3.11 (dd, J = 11.7, 7.2 Hz, 1H), 2.84 (s, 3H), 2.22 (s, 3H).

5 Reference example 23(9)

(2S)-2-hydroxymethyl-7-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0270]



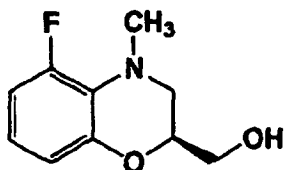
TLC:Rf 0.29 (hexane: ethyl acetate=2:1);

NMR(CDCl₃): δ 6.59 and 6.57 (each m, total 3H), 4.41-4.31 (m, 1H), 3.86 (dd, J = 12.0, 4.2 Hz, 1H), 3.80 (dd, J = 12.0, 5.4 Hz, 1H), 3.19 (dd, J = 11.4, 3.0 Hz, 1H), 3.12 (dd, J = 11.4, 7.2 Hz, 1H), 2.84 (s, 3H).

25 Reference example 23(10)

(2S)-2-hydroxymethyl-5-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0271]



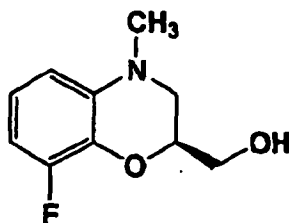
TLC:Rf 0.41 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 6.80-6.60 (m, 3H), 4.17-4.05 (m, 1H), 3.97-3.77 (m, 2H), 3.18-3.03 (m, 2H), 2.94 (d, J = 1.8 Hz, 3H), 2.02-1.92 (m, 1H).

Reference example 23(11)

(2S)-2-hydroxymethyl-8-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazine

[0272]

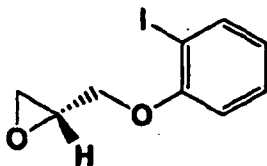


TLC:Rf 0.26 (hexane: ethyl acetate=1:1);

NMR(CDCl₃): δ 6.80-6.62 (m, 1H), 6.55-6.41 (m, 2H), 4.40-4.28 (m, 1H), 3.95-3.79 (m, 2H), 3.25 (d, J = 5.1 Hz, 2H), 2.90 (s, 3H).Reference example 24

(2R)-2-((2-iodophenoxy)methyl)oxirane

[0273]



[0274] Under argon gas, 2-iodophenol (1.70g) was dissolved to N, N-dimethyl formamide (15ml), and (R)-glycidyl nosylate (2.00g) and cesium carbonate (3.78g) added, and then the mixture was stirred during 30 minutes at room temperature. Water is added to the reactive mixture, which was extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine and dried by anhydrous sodium sulfate. The residue by removal of the solvent was purified by silica gel column chromatography (hexane: ethyl acetate=1:5) to a title compound (2.07g) having the following physical properties.

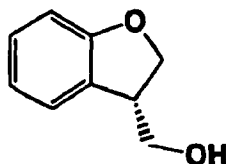
TLC:Rf 0.35 (hexane: ethyl acetate=1:5);

NMR(CDCl₃): δ 7.78 (dd, J = 7.5, 1.5 Hz, 1H), 7.32-7.27 (m, 1H), 6.85 (dd, J = 8.1, 1.2 Hz, 1H), 6.74 (dt, J = 1.2, 7.5 Hz, 1H), 4.29 (dd, J = 11.1, 3.0 Hz, 1H), 4.07 (dd, J = 4.8, 3.0 Hz, 1H), 3.43-3.38 (m, 1H), 2.95-2.89 (m, 2H).

Reference example 25

(3S)-3-hydroxymethyl-2,3-dihydrobenzofuran

[0275]



[0276] Under argon gas, the compound (1.00g) prepared according to reference example 24 was dissolved to anhydrous tetrahydrofuran (10ml), and n-butyllithium (1.59M hexane solution, 2.28ml) was added at -78°C, and then the mixture was stirred at the same temperature for 1 hour. The reactive mixture was risen up to room temperature, where 1N hydrochloric acid was added. The reactive mixture was extracted by ethyl acetate, and the organic layer was sequentially washed with water and saturated brine and dried by anhydrous sodium sulfate. The residue by removal of the solvent was purified by silica gel column chromatography (hexane: ethyl acetate=3:2) to give a title compound (376mg) having the following physical properties.

TLC:Rf 0.35 (hexane: ethyl acetate=3:2);

NMR(CDCl₃):δ 7.26-7.14 (m, 2H), 6.90-6.80 (m, 2H), 4.64 (t, J = 9.0 Hz, 1H), 4.48 (dd, J = 9.0, 5.4 Hz, 1H), 3.82-3.80 (m, 2H), 3.69-3.60 (m, 1H).

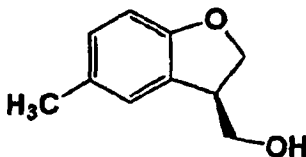
Reference example 25(1) to (6)

[0277] Instead of 2-iodophenol, using the corresponding phenol derivative, a compound of the present invention having the following physical properties values was obtained by an operation similar to a method sequentially represented by reference example 24 and reference example 26.

Reference example 25(1)

(3R)-3-hydroxymethyl-5-methyl-2,3-dihydrobenzofuran

[0278]



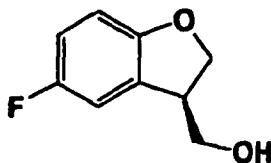
TLC:Rf 0.32 (hexane: ethyl acetate=2:1);

NMR(CDCl₃):δ 7.03 (s, 1H), 6.96 (m, 1H), 6.70 (d, J = 8.4 Hz, 1H), 4.62 (t, J = 9.0 Hz, 1H), 4.45 (dd, J = 9.0, 5.1 Hz, 1H), 3.86-3.73 (m, 2H), 3.67-3.53 (m, 1H), 2.29 (s, 3H).

Reference example 25(2)

(3R)-3-hydroxymethyl-5-fluoro-2,3-dihydrobenzofuran

[0279]

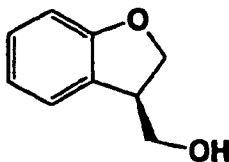


TLC:Rf 0.35 (hexane: ethyl acetate=2:1);

NMR(CDCl₃): δ 7.10 (dd, J = 8.1, 6.0 Hz, 1H), 6.63-6.53 (m, 2H), 4.67 (t, J = 9.0 Hz, 1H), 4.59 (dd, J = 9.0, 5.1 Hz, 1H), 4.00-3.74 (m, 3H).Reference example 25(3)

(3R)-3-hydroxymethyl-2,3-dihydrobenzofuran

[0280]

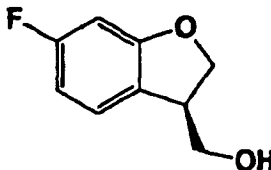


TLC:Rf 0.40 (hexane: ethyl acetate=3:2);

NMR(CDCl₃): δ 7.26-7.14 (m, 2H), 6.90-6.80 (m, 2H), 4.64 (t, J = 9.0 Hz, 1H), 4.48 (dd, J = 9.0, 5.4 Hz, 1H), 3.82-3.80 (m, 2H), 3.69-3.60 (m, 1H).Reference example 25(4)

(3R)-3-hydroxymethyl-6-fluoro-2,3-dihydrobenzofuran

[0281]

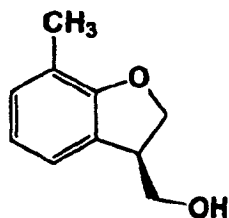


TLC:Rf 0.53 (hexane: ethyl acetate=1:1);

Reference example 25(5)

(3R)-3-hydroxymethyl-7-methyl-2,3-dihydrobenzofuran

[0282]



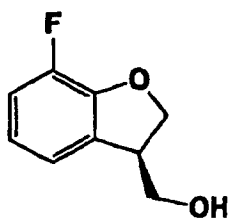
TLC:Rf 0.53 (hexane: ethyl acetate=1:1);

NMR(CDCl₃): δ 7.05 (d, J = 7.5 Hz, 1H), 6.98 (d, J = 7.5 Hz, 1H), 6.78 (t, J = 7.5 Hz, 1H), 4.64 (t, J = 9.0 Hz, 1H), 4.48 (dd, J = 9.0, 5.7 Hz, 1H), 3.85-3.72 (m, 2H), 3.70-3.60 (m, 1H), 2.21 (s, 3H).

Reference example 25(6)

(3R)-3-hydroxymethyl-7-fluoro-2,3-dihydrobenzofuran

[0283]



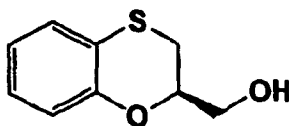
TLC:Rf 0.60 (hexane: ethyl acetate=1:2);

Reference example 26

Instead of the compound prepared from reference example 10, using 2-fluorothiophenol, a title compound having the following physical properties values was obtained by an operation similar to a method sequentially represented by reference example 11 and reference example 12.

(2R)-2-hydroxymethyl-1,4-benzoxathiane

[0285]



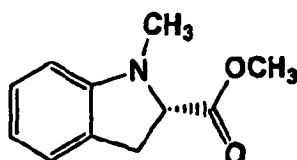
TLC:Rf 0.20 (hexane: ethyl acetate=3:1);

NMR(CDCl₃): δ 7.10-6.80 (m, 4H), 4.28 (m, 1H), 4.00-3.75 (m, 2H), 3.13 (dd, J = 13.2, 8.8 Hz, 1H), 2.95 (dd, J = 13.2, 2.2 Hz, 1H).

Reference example 27

(2S)-1-methylindoline-2-carboxylic methyl ester

[0286]

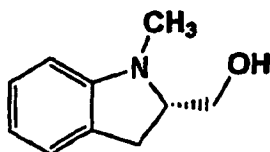


[0287] (S)-(-)-indoline-2-carboxylic acid (2.0g) was dissolved to a mixture of acetone (20ml) and N, N-dimethylformamide (20ml), and potassium carbonate (6.78g) and methyl iodide (3.05ml) were added at room temperature. The reactive mixture was stirred at room temperature over night, and then filtered. The filtrate was concentrated by vacuum concentration and the obtained residue was diluted with ethyl acetate. The solution is poured into water and the water layer has been extracted by ethyl acetate. The organic layer was sequentially washed with water and saturated brine, and then dried by anhydrous sodium sulfate. The residue by removal of the solvent was purified by silica gel column chromatography (hexane: ethyl acetate=4:1) to give a title compound (1.7g) having the following physical properties. TLC:Rf 0.70 (hexane: ethyl acetate=7:3); NMR(CDCl₃): δ 7.11 (t, J = 7.5 Hz, 1H), 7.05 (d, J = 7.5 Hz, 1H), 6.70 (t, J = 7.5 Hz, 1H), 6.51 (d, J = 7.5 Hz, 1H), 4.05 (t, J = 9.6 Hz, 1H), 3.80 (s, 3H), 3.34 (dd, J = 15.6, 9.6 Hz, 1H), 3.13 (dd, J = 15.6, 9.6 Hz, 1H), 2.84 (s, 3H).

Reference example 28

(2S)-2-hydroxymethyl-1-methylindoline

[0288]



[0289] Anhydrous tetrahydrofuran solution (10ml) of the compound (1.7g) prepared according to reference example 27 was dropped to anhydrous tetrahydrofuran solution (20ml) containing lithium aluminumhydride (675mg), which was stirred at room temperature for 1 hour. The reactive mixture was diluted with ether, and saturated brine was dropped, and then the mixture was dried by anhydrous sodium sulfate. The reactive mixture was filtered and the filtrate was concentrated by vacuum concentration to give a title compound (1.4g) having the following physical properties.

TLC:Rf 0.30 (hexane: ethyl acetate=7:3);

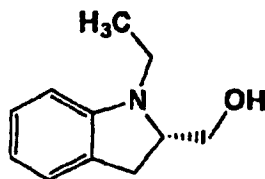
NMR(CDCl₃): δ 7.16-7.05 (m, 2H), 6.73 (t, J = 7.5 Hz, 1H), 6.55 (d, J = 7.5 Hz, 1H), 3.95 (dd, J = 11.7, 3.6 Hz, 1H), 3.74-3.60 (m, 1H), 3.56-3.44 (m, 1H), 3.16-2.96 (m, 2H), 2.77 (s, 3H), 1.94-1.76 (m, 1H).

Reference example 28(1)

(2S)-2-hydroxymethyl-1-ethylindoline

5 [0290]

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[0291] Using ethyl iodide instead of methyl iodide, a title compound having the following physical properties values was obtained by an operation similar to a method sequentially represented by reference example 27 and reference example 28.

20 TLC:Rf 0.35 (hexane: ethyl acetate=7:3);

NMR(CDCl₃): δ 7.08 (t, J = 7.5 Hz, 1H), 7.06 (d, J = 7.5 Hz, 1H), 6.69 (t, J = 7.5 Hz, 1H), 6.51 (d, J = 7.5 Hz, 1H), 3.88 (dd, J = 11.4, 3.6 Hz, 1H), 3.78 (m, 1H), 3.64 (brd, J = 11.4 Hz, 1H), 3.40-3.10 (m, 2H), 3.06 (dd, J = 8.7, 2.7 Hz, 2H), 1.98 (brs, 1H), 1.13 (t, J = 7.2 Hz, 3H).

25 Example 17

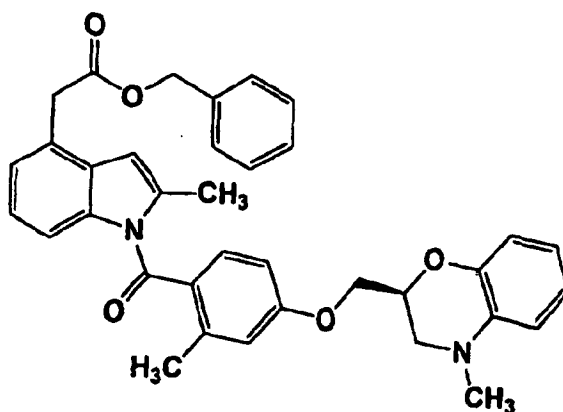
1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-2-methyl-1H-indol-4-yl acetic acid benzyl ester

30 [0292]

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[0293] Using 4-hydroxy-2-methylbenzoic acid methyl instead of 4-hydroxybenzoate methyl, a compound of the present invention having the following physical properties values was obtained by an operation similar to a method sequentially represented by reference example 17, reference example 28, and example 1(1).

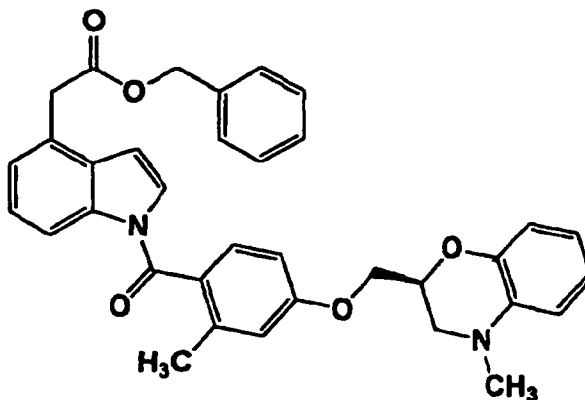
55 TLC:Rf 0.44 (hexane: ethyl acetate=7:3);

NMR(CDCl₃): δ 7.40-7.20 (m, 6H), 7.10-6.76 (m, 7H), 6.75-6.66 (m, 2H), 6.43 (brs, 1H), 5.14 (s, 2H), 4.72-4.62 (m, 1H), 4.29 (dd, J = 9.6, 4.8 Hz, 1H), 4.18 (dd, J = 9.6, 6.3 Hz, 1H), 3.86 (s, 2H), 3.41 (dd, J = 11.7, 2.7 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H), 2.32 (s, 3H), 2.31 (s, 3H).

Example 17(1)

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-1H-indol-4-yl acetic acid benzyl ester

[0294]



[0295] By subjecting a compound obtained by an operation similar to a method sequentially represented by reference example 1, reference example 2, reference example 3, reference example 4, reference example 5, and reference example 6 using 2-methyl-4-hydroxy-1H-indole instead of 4-hydroxy-1H-indole and a compound obtained by an operation similar to a method sequentially represented by reference example 17 and reference example 18 using 4-hydroxy-2-methylbenzoic acid methyl instead of 4-hydroxybenzoate methyl to an operation similar to method represented by example 1(1), the compound of the present invention having the following physical properties values was obtained.

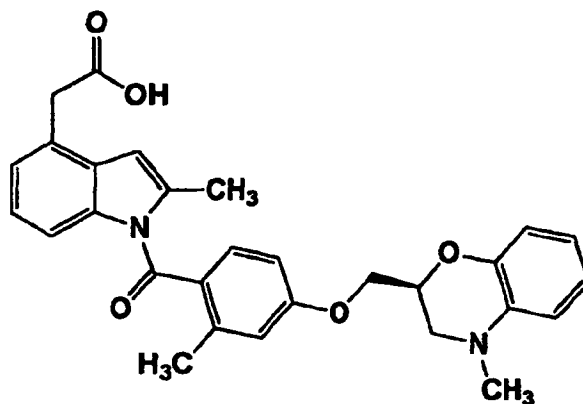
TLC:Rf 0.36 (hexane: ethyl acetate=9:1);

NMR(CDC₃) δ 8.26 (d, J = 8.7 Hz, 1H), 7.38-7.20 (m, 8H), 7.11 (d, J = 3.6 Hz, 1H), 6.93-6.82 (m, 2H), 6.63 (d, J = 3.6 Hz, 1H), 5.13 (s, 2H), 4.73-4.63 (m, 1H), 4.29 (dd, J = 9.6, 5.1 Hz, 1H), 4.18 (dd, J = 9.6, 6.6 Hz, 1H), 3.92 (s, 2H), 3.41 (dd, J = 11.7, 3.0 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.93 (s, 3H), 2.34 (s, 3H), 2.05 (s, 3H).

Example 18

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-2-methyl-1H-indol-4-yl acetic acid

[0296]



[0297] Using the compound prepared according to example 17 instead of the compound prepared according to example 1, a compound of the present invention having the following physical properties values was obtained by an operation similar to example 2.

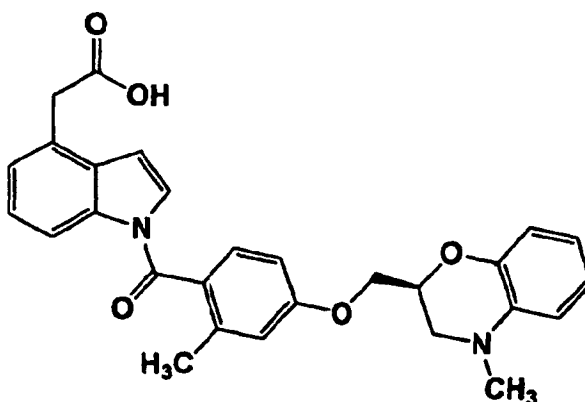
TLC=R_f 0.53 (chloroform: methanol=9:1);

NMR(CDCl₃): δ 7.31 (d, J = 8.7 Hz, 1H), 7.10-6.98 (m, 3H), 6.92-6.76 (m, 4H), 6.75-6.67 (m, 2H), 6.47 (s, 1H), 4.72-4.62 (m, 1H), 4.28 (dd, J = 9.9, 5.4 Hz, 1H), 4.18 (dd, J = 9.9, 6.3 Hz, 1H), 3.85 (s, 2H), 3.41 (dd, J = 11.4, 2.7 Hz, 1H), 3.27 (dd, J = 11.4, 6.6 Hz, 1H), 2.92 (s, 3H), 2.35 (s, 3H), 2.32 (s, 3H).

Example 18(1)

1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-1H-indol-4-yl acetic acid

[0298]



[0299] Using the compound prepared according to example 17(1) instead of the compound prepared according to example 1, a compound of the present invention having the following physical properties values was obtained by an

operation similar to example 2.

TLC:Rf 0.43 (chloroform: methanol=9:1);

NMR(CDCI₃): δ 8.27 (d, J = 8.1 Hz, 1H), 7.38-7.30 (m, 2H), 7.28-7.18 (m, 1H), 7.14 (d, J = 3.9 Hz, 1H), 6.94-6.80 (m, 4H), 6.76-6.67 (m, 2H), 6.64 (d, J = 3.9 Hz, 1H), 4.72-4.62 (m, 1H), 4.29 (dd, J = 9.9, 4.8 Hz, 1H), 4.18 (dd, J = 9.9, 6.6 Hz, 1H), 3.90 (s, 2H), 3.41 (dd, J = 11.7, 2.7 Hz, 1H), 3.28 (dd, J = 11.7, 6.6 Hz, 1H), 2.92 (s, 3H), 2.34 (s, 3H).

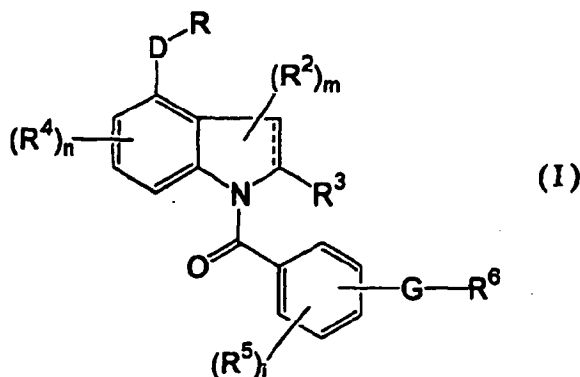
Formulation Example 1

[0300] The following components were admixed in conventional method and punched out to obtain 100 tablets each containing 5 mg of active ingredient.

- 1-(4-((2R)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid 500mg
- Carboxymethyl cellulose calcium (disintegrator) 200mg
- Magnesium stearate (lubricant) 100mg
- Microcrystalline cellulose 9.2g

Claims

1. An indole derivative represented by formula (I):



wherein R represents -COR¹, -CH₂OR⁰, or -COOR²⁰, R⁰ represents a hydrogen atom or C2-6 acyl group, R¹ represents a hydroxyl group, C1-6 alkoxy group, -NR⁸R⁹ wherein R⁸ and R⁹ each represents hydrogen atom, C1-6 alkyl group, -SO₂R¹³ wherein R¹³ represents C1-6 alkyl group, C3-15 saturated or unsaturated carbocyclic ring, or 4 to 15-membered heterocycle containing 1 to 5 of nitrogen atom(s) sulfur atom(s) and/or oxygen atom(s), R²⁰ represents allyl or benzyl group,

R² represents a hydrogen atom, C1-6 alkyl, C1-6 alkoxy, C2-6 alkoxyalkyl, a halogen atom, amino, trihalomethyl, cyano, hydroxyl, benzyl, or 4-methoxybenzyl group,

R³ represents a hydrogen atom, C1-6 alkyl, C1-6 alkoxy, a halogen atom, trihalomethyl, cyano, or hydroxyl group,

R⁴ and R⁵ each represents a hydrogen atom, C1-6 alkyl, C1-6 alkoxy, C2-6 alkoxyalkyl group, a halogen atom, nitro, amino, trihalomethyl, trihalomethoxy, cyano or hydroxyl group,

D represents a single bond, C1-6 alkylene, C2-6 alkenylene, or C1-6 oxyalkylene group,

-G-R⁶ represents

1) G represents C1-6 alkylene that may be replaced by 1 or 2 of oxygen atom(s) and/or sulfur atom(s), C2-6 alkenylene that may be replaced by 1 or 2 of oxygen atom(s) and/or sulfur atom(s), wherein the alkylene and alkenylene groups may be substituted by hydroxyl or C1-4 alkoxy group, -C(O)NH-, -NHC(O)-, -SO₂NH-, -NHSO₂-, or diazo group,

R⁶ represents C3-15 saturated or unsaturated carbocyclic ring, or a 4 to 15-membered heterocycle containing 1 to 5 of nitrogen atom(s) sulfur atom(s), and/or oxygen atom(s), wherein the rings may be substituted by 1 to 5 group(s) selected from C1-6 alkyl, C1-10 alkoxy, C2-6 alkoxyalkyl, a halogen atom, hydroxyl, trihalomethyl, nitro,

amino, phenyl, phenoxy, oxo, C2-6 acyl, C1-6 alkane sulphonyl, and cyano group, or

2) together with G and R⁶,

- (i) C1-15 alkyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s),
 (ii) C2-15 alkenyl group that may be replaced by 1 to 5 of oxygen atom(s) and/or sulfur atom(s), wherein the alkyl, alkenyl, and alkynyl groups may be substituted by 1 to 12 of groups selected from C1-6 alkoxy, a halogen atom, hydroxyl, cyano, oxo groups, and -NR¹¹R¹² wherein R¹¹ and R¹² represent hydrogen atoms, C1-6 alkyl, C2-6 alkenyl, phenyl, benzoyl, naphthyl, phenyl groups substituted with C1-6 alkyl group, or C1-6 alkyl group substituted by phenyl or cyano group, respectively,

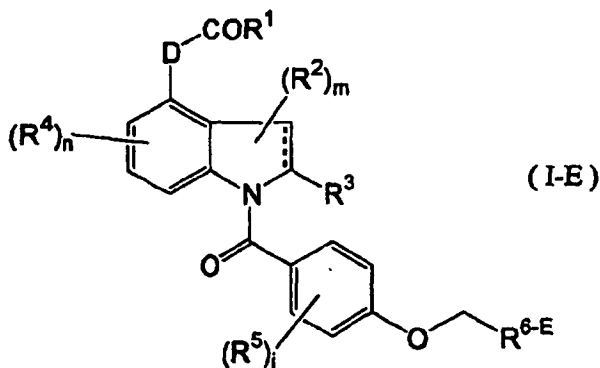
n represents 1 to 3,

m represents 1 to 3,

i represents 1 to 4,

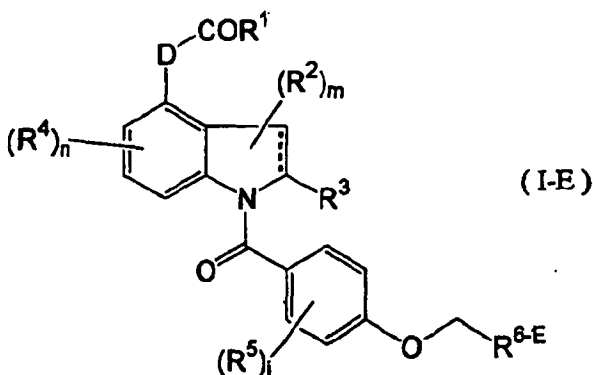
— represents a single bond or a double bond, or non-toxic salts thereof.

2. The indole derivative of claim 1, which is represented by formula (I-E):



wherein R^{6-E} represents the same meaning as R⁶ of claim 1; and wherein, the carbon atom with which R^{6-E} binds is saturated and the configuration of the carbon atom is S arrangement, other symbols represent the same meaning as that of claim 1, or a non-toxic salt thereof.

3. The indole derivative of claim 1, which is represented by formula (I-E):



wherein R^{6-E} represents the same meaning as R⁶ of claim 1, and wherein the carbon atom with which R^{6-E} binds is saturated and the configuration of the carbon atom is R arrangement, and other symbols represent the same meaning as that of claim 1, or a non-toxic salt thereof.

4. The indole derivative of claim 1, wherein R represents $-\text{CH}_2\text{OR}^0$, wherein R^0 represents the same meaning as that of claim 1 in formula (I), or a non-toxic salt thereof.

5. The indole derivative of claim 2 or 3, wherein R represents $-\text{COOR}^{20}$, wherein R^{20} represents the same meaning as that of claim 1 in formula (I), or non-toxic salts thereof.

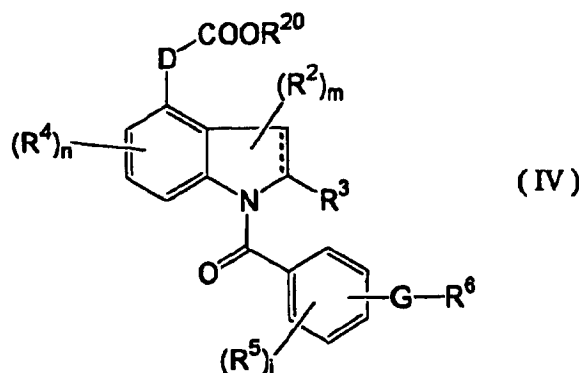
6. The indole derivative of claim 1, which is a compound selected from

- (1) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid benzyl ester,
- (2) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (3) 1-(4-((2R)-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (4) 1-(4-((2S)-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indole-4-yl acetic acid,
- (5) 1-(4-((2S)-1-methylindolin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (6) 1-(4-((2R)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (7) 1-(4-((2S)-4,6-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (8) 1-(4-((2S)-6-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (9) 1-(4-((2S)-6-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (10) 1-(4-((2S)-7-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (11) 1-(4-((2S)-4, 7-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (12) 1-(4-((2S)-7-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (13) 1-(4-((2S)-1-ethylindolin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (14) 1-(4-((2S)-4, 8-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (15) 1-(4-((2S)-5-methoxy-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (16) 1-(4-((2S)-5-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (17) 1-(4-((2S)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (18) 1-(4-((2R)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (19) 1-(4-((2S)-8-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (20) 1-(4-((2R)-1,4-benzoxathian-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (21) 1-(4-((3S)-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (22) 1-(4-((3R)-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (23) 1-(4-((3R)-5-fluoro-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (24) 1-(4-((3R)-5-methyl-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (25) 1-(4-((3R)-6-fluoro-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (26) 1-(4-((3R)-7-methyl-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (27) 1-(4-((2R)-5-fluoro-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (28) 1-(4-((2S)-8-fluoro-1,4-benzodioxan-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (29) 1-(4-((3R)-7-fluoro-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl acetic acid,
- (30) 3-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acrylic acid allyl ester,
- (31) 3-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acrylic acid,
- (32) 3-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)propanoic acid,
- (33) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl oxyacetic acid benzyl ester,

- (34) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)oxyacetic acid,
 (35) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-carboxylic acid benzyl ester,
 (36) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-carboxylic acid,
 (37) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-1H-indol-4-yl acetic acid benzyl ester,
 (38) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-1H-indol-4-yl acetic acid,
 (39) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2,3-dihydro-1H-indol-4-yl acetic acid,
 (40) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-2,3-dihydro-1H-indol-4-yl acetic acid,
 (41) 2-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol,
 (42) 2-(1-(4-((2S)-4,6-dimethyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol,
 (43) 2-(1-(4-((2S)-6-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol,
 (44) 2-(1-(4-((2S)-7-fluoro-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol,
 (45) 2-(1-(4-((2S)-2,3-dihydrobenzofuran-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol,
 (46) 2-(1-(4-((3R)-2,3-dihydrobenzofuran-3-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethanol,
 (47) N-methylsulfonyl-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acetamide,
 (48) N-phenylsulfonyl-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)acetamide,
 (49) 2-(1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)benzoyl)-2-methyl-1H-indol-4-yl)ethyl acetate,
 (50) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-2-methyl-1H-indol-4-yl acetic acid benzyl ester,
 (51) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-1H-indol-4-yl acetic acid benzyl ester,
 (52) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-2-methyl-1H-indol-4-yl acetic acid, and
 (53) 1-(4-((2S)-4-methyl-3,4-dihydro-2H-1,4-benzoxazin-2-ylmethoxy)-2-methylbenzoyl)-1H-indol-4-yl acetic acid or a non-toxic salt thereof,

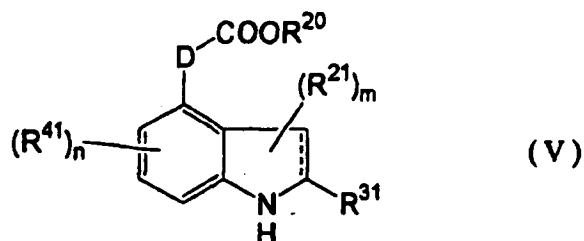
or a non-toxic salts thereof.

7. A production method of a compound represented by formula (IV)

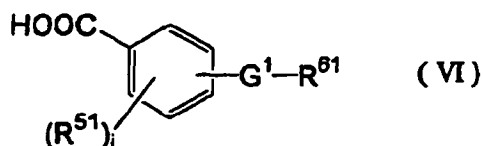


wherein R^{20} represents aryl or benzyl group, and other symbols represent the same meaning as that of claim

1, which comprises subjecting a compound represented by formula (V)

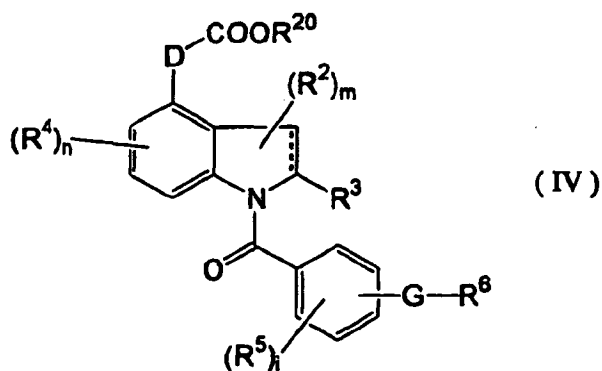


15 wherein R²⁰ represents aryl or benzyl group and R²¹, R³¹, and R⁴¹ represent the same meaning as R², R³, and R⁴ of claim 1 respectively; and wherein they are protected by protecting groups when they represent amino or hydroxyl group, and other symbols represent the same meaning as that of claim 1 and a compound represented by formula (VI)

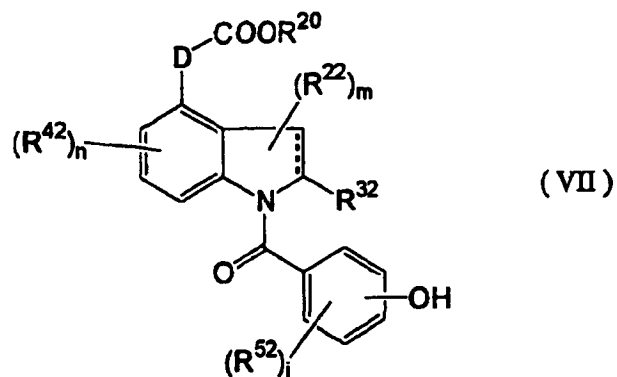


30 wherein R⁵¹ represents the same meaning as R⁵ of claim 1; and wherein they are protected by protecting groups when R⁵¹ represents amino or hydroxyl group, and G¹ and R⁶¹ represent the same meaning as G and R⁶ of claim 1, respectively; and wherein they are protected by protecting groups when they contain amino or hydroxyl group to amidation reaction, followed by deprotection reaction optionally.

8. A production method of a compound represented by formula (IV)



50 wherein R²⁰ represents aryl or benzyl group, and other symbols represent the same meaning as that of claim 1, which comprises by subjecting a compound represented by formula (VII)

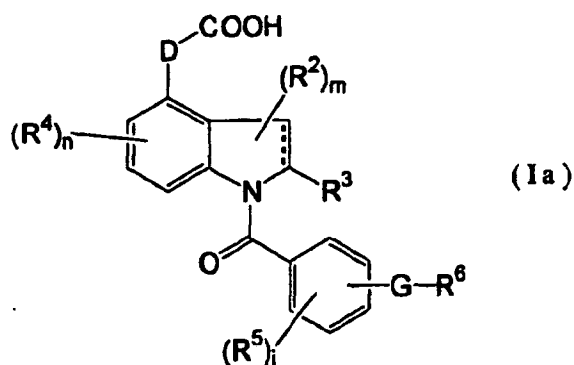


wherein R^{52} represents the same meaning as R^2 , R^3 , R^4 , and R^5 of claim 1 respectively; and wherein they are protected by protecting groups when they represent amino or hydroxyl group, and other symbols represent the same meaning as claim 1. and a compound represented by formula (VIII)



25 wherein R^{62} represents the same meaning as R^6 of claim 1; and wherein they are protected by protecting groups when they contain amino or hydroxyl group, and J represents $-\text{CH}_2-$ to etherification reaction, followed by deprotection reaction optionally.

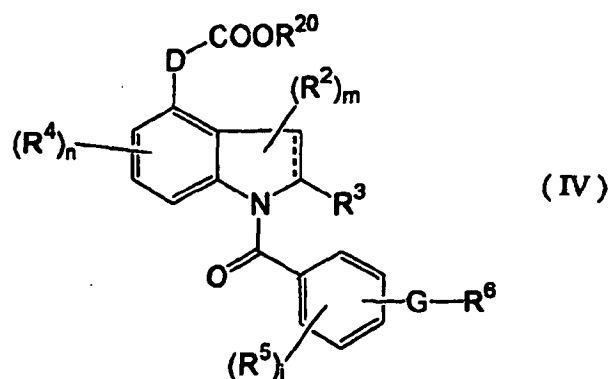
9. A production method of a compound represented by formula (Ia)



45 wherein all symbols represent the same as that of claim 1, which comprises subjecting a compound represented by formula (IV)

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wherein R^{20} represents aryl or benzyl group, and other symbols represent the same meaning as that of claim 1 to deprotection reaction of allyl ester or benzyl ester.

- 20 10. A medicinal composition comprising the indole derivative compound represent by formula (I) of claim 1 or a non-toxic salt thereof as an active ingredient.
11. A PGD_2 receptor antagonist comprising the indole derivative compound represent by formula (I) of claim 1 or a non-toxic salt thereof as an active ingredient.
- 25 12. The antagonist of claim 11, wherein PGD_2 receptor is DP receptor.
13. A preventive and/or treatment medicine for allergic diseases (allergic rhinitis, allergic conjunctivitis, atopic dermatitis, bronchial asthma, food allergy, etc.), systemic mastocytosis, disorders due to systemic mastocyte activation, anaphylactic shock, bronchoconstriction, urticaria, eczema, psoriasis, allergic bronchopulmonary aspergillosis, paranasal sinusitis, migraine, nasal polyp, hypersensitive angitis, eosinophilia, contact dermatitis, diseases accompanied with itching (such as atopic dermatitis, urticaria, allergic conjunctivitis, allergic rhinitis, contact dermatitis, etc.), secondary diseases (such as cataracta, retinodialysis, inflammation, infection, dysgryphia, etc.) generated by behaviors caused by itching (scratching behaviors, beating, etc.), inflammation, chronic obstructive pulmonary disease, ischemic reperfusion disorder, cerebrovascular disorder, brain damage, hepatopathy, graft rejection, autoimmune disease, rheumatoid arthritis, pleuritis complicated by rheumatoid arthritis, osteoarthritis, crohn's disease, ulcerative colitis, or pain, comprising the indole derivative compound represent by formula (I) of claim 1 or a non-toxic salt thereof as an active ingredient.
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/09077

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.⁷ C07D209/12, 405/12, 411/12, 413/12, A61K31/405, 31/538,
A61P1/00, 7/00, 7/02, 9/08, 11/00, 11/02, 11/06, 17/00,
25/20, 27/02, 29/00, 31/00, 37/08, 43/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl.⁷ C07D209/12, 405/12, 411/12, 413/12, A61K31/405, 31/538,
A61P1/00, 7/00, 7/02, 9/08, 11/00, 11/02, 11/06, 17/00,
25/20, 27/02, 29/00, 31/00, 37/08, 43/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
CAPLUS, REGISTRY (STN)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 780389 A1 (Tobishi Pharm. Co., Ltd.), 25 June, 1997 (25.06.97), & JP 9-176162 A & CA 2193171 A & US 5811439 A & AU 9676406 A & CN 1167111 A & WO 98/57971 A1	1, 4, 5, 7-9
A	EP 458642 A1 (Wellcome Found., Ltd.), 27 November, 1991 (27.11.91), & CN 1057458 A & US 5147885 A & JP 7-2792 A	1-13
P, X	WO 01/66520 A1 (Ono Pharm. Co., Ltd.), 13 September, 2001 (13.09.01), (Family: none)	1-13

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

& document member of the same patent family

Date of the actual completion of the international search
05 November, 2002 (05.11.02)

Date of mailing of the international search report
19 November, 2002 (19.11.02)

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